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ABSTRACT

The symposium summary presents the opening remarks of the meeting and nine papers which focus on defining manpower research within the context of educational program planning and decision making and include detailed analyses of the supply and demand of selected occupations. The papers are: "Manpower Research and Information, An Educational Viewpoint," Stephen J. Franchak; "A Comprehensive Supply/Demand Model for Education," John Senier; "Manpower Research and Information, Federal Bureau of Labor Statistics Viewpoint," Myron H. Levine; "Some Implications for Educators of the Findings in the Report, A Study of Physician Manpower Supply and Demand in Pennsylvania," George E. Brehman, Jr.; "Dental Manpower Supply and Demand in Pennsylvania," Frank M. Durkee; "Overview of Comm-Bacc Survey Efforts in Pennsylvania," William P. Donny; "Some Comments on Engineering Manpower Over the Next Decade with Reference to Higher Education Needs," George E. Brehman, Jr.; "Teacher Manpower Supply and Demand in Pennsylvania," Frank M. Durkee; and "Demand, Supply and Educational Requirements in Allied Health and Health-Related Occupations," Alfonso S. Zawadski. (JB)

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# MANPOWER RESEARCH AND INFORMATION

Proceedings of a Symposium held at
the Holiday Inn Town, Harrisburg, Pennsylvania
April 25, 1974

Prepared by
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1974

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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TABLE OF CONTENTS


PREFACE . . . . . v

OVERVIEW . . . . . vii

SUMMARY OF OPENING REMARKS . . . . . viii

Manpower Research and Information: An Educational Viewpoint . . . . . 1

A Comprehensive Supply/Demand Model for Education . . . . . 5

Manpower Research and Information: Federal Bureau of Labor Statistics Viewpoint . . . . . 12

Some Implications for Educators of the Findings in the Report: A Study of Physician Manpower Supply and Demand in Pennsylvania . . . . . 15

Dental Manpower Supply and Demand in Pennsylvania . . . . . 20

Overview of Comm-Bacc Survey Efforts in Pennsylvania . . . . . 28

Some Comments on Engineering Manpower Over the Next Decade with Reference to Higher Education Needs . . . . . 32

Teacher Manpower Supply and Demand in Pennsylvania . . . . . 37

Demand, Supply and Educational Requirements in Allied Health and Health-Related Occupations . . . . . 45

# PREFACE

In most organizations there is always room for improvement in the planning and decision-making system and education is no exception.

If we agree that education has as its primary objective the satisfying of both individual student needs and those of society, one thing we must improve upon is the use of various data in the planning scheme. These data, to mention a few, include manpower, economic, demographic and related information. Logically, it would seem that if these data were used in systematic planning and decision-making as a means to satisfy the objective of both students and community (be it labor market area, county, region, state or nation) educational accountability could be more tenable.

Educational planning and programming are not easy tasks. They are extremely difficult, requiring much effort which is often complicated by many unforeseen things and people with differing viewpoints. It involves the use of accurate data and the subsequent manipulation of the data in such a form that it can be used as reliable and valid information.

Individuals and institutions differ in their approach to planning and the making of decisions about program offerings. Some feel that the free-choice method, where the goal is to provide education in response to the student's choices, is suitable for our society. Others believe that the manpower-requirements method, where the goal is to produce the right number of individuals for various occupations, is more realistic in light of our industrial-oriented society. It is agreed by many that the debate over which position is best will probably continue indefinitely. However, a complete understanding of both sides appears to be lacking and maybe an in-between position is worthy of consideration.

With this in mind, certain individuals of the Pennsylvania Department of Education, while recognizing the varied manpower research and information efforts both within and outside the department, decided to sponsor a manpower research and information symposium relative to educational planning and decision-making.

The primary purpose was to share with educators and other interested persons of the Commonwealth the results of the Pennsylvania Department of Education manpower research efforts. These studies focus on a computer-based system for generating occupational supply/demand data; special interest studies concerning teachers, physicians, dentists, allied health personnel, engineers; and an analysis of postbaccalaureate degree activities of graduates in the labor market.

Equally important was the wish to bring together those persons who are working in or concerned with this area. Also, it is the desire of the department to facilitate the achievement of common goals, to avoid duplication and hopefully develop collective efforts rather than separate ones in isolation.

This publication includes a summary of the opening remarks by Seon H. Cho, director of the Bureau of Information Systems; John C. Pittenger, Secretary of Education; Gail Rose, member of the State Board of Education; and nine papers presented at the symposium. These papers focus on defining manpower research

within the context of educational program planning and decision-making and include a detailed analysis of the supply/demand of selected occupations.

Stephen J. Franchak
Coordinator of Manpower Research

# OVERVIEW

## Manpower Research and Information

### Symposium Purpose

To provide an opportunity for educators and interested persons of the Commonwealth to share in the results of the Pennsylvania Department of Education manpower research efforts.

To provide participants an opportunity to exchange ideas with individuals who are working in or concerned with this area.

### Symposium Problem

Educational planning and programming are not easy tasks. It is important that persons involved be knowledgeable about and use data and information to support these efforts. These data, to mention a few, include manpower, economic, demographic and related information.

### Symposium Objectives

The symposium will increase the awareness and knowledge of the participants in the manpower research areas of:

- relationship to educational planning and programming
- occupational supply/demand model
- occupational projection techniques
- physician manpower supply/demand
- dental manpower supply/demand
- allied health manpower supply/demand
- follow-up study of baccalaureate degree graduates

## SUMMARY OF OPENING REMARKS

Opening remarks for the symposium were made by Seon H. Cho, director of the Bureau of Information Systems; John C. Pittenger, Secretary of Education; and Gail Rose, chairman of the manpower subcommittee, State Board of Education.

Dr. Cho stated that the primary need for manpower research is to shed some insight into the human resource supply and demand factors that have a direct relevance to educational planning and programming. He added that although extensive research has been done, more questions have been raised relative to manpower research for educational planning and programming. He invited the participants to examine the research effort to date and analyze it within their own frame of reference.

Secretary Pittenger, in recognizing the importance of valid information for planning and decision-making, emphasized the complexity of the task but indicated that we must commit our resources to this research which is so urgently needed. He cited two goals for guiding the effort. These were:

- The establishment of a centralized system to generate manpower research and information.

- Provisions for adequate dissemination of manpower research and information to agencies responsible for educational program planning and decision-making.

Gail Rose, representing the State Board of Education, spelled out the historical efforts toward bringing some semblance of order to this area of research and the fact that it has taken a long time to get to where we are now. He indicated that we are at the point where representatives of higher education are sitting down to talk to each other and with Department of Education people. The topic of concern involves the projected needs of the state, the nation and the people so that to some extent, at least, educational offerings can be tailored to fit these needs and individuals can select a career path with a little more certainty of what may lie at the end of that path.

# MANPOWER RESEARCH AND INFORMATION: AN EDUCATIONAL VIEWPOINT

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Manpower research means many things to many people. And almost nowhere is this more prevalent, particularly in the past decade and more so in this one, than in the area of manpower research and information.

My remarks this morning will be guided by that statement. Because my approach is that of a smorgasbord, deliberately planned, hopefully not to confuse nor bore you but to whet your appetite for what will follow this morning and afternoon.

I will not provide you with new and earthshaking ideas or comments, and for many of you, I am sure, this will be old soap, but old soap is better than no soap for cleaning up dirty problems. In my opinion, educational program planners and decision-makers, be they state or local administrators and their staff or the students--supposedly the prime users of manpower research and information--certainly have problems, some of their own volition, others as a result of socioeconomic, sociopolitical and sociotechnological problems that prevail.

Before I get into the nitty-gritty, let me define some terms so that we can limit the "many things to many people" problem.

- Manpower. The power of human beings, both in terms of size of population and capabilities, be they cognitive or psychomotor, in that population.

- Manpower Research. The study of the quantitative and qualitative human assets of people in a given society (Patten, 1971, p. 11) for the purposes of the Department of Education, more specifically defined as the study of occupational supply and occupational demand data, including subsequent information and related factors. This includes a study and utilization of various models and projection techniques for producing supply/demand data.

- Manpower Planning. Concerned with the matching of manpower requirements and available resources (Bartholomew, Morris, 1971, p. 2), or more specifically, "the process by which an organization ensures that it has the right number of people and the right kind of people at the right places, at the right time doing things for which they are economically most useful" (Patten, 1971, p. 33). Let me add that they then possess a high degree of satisfaction with the position and functions associated with that position.

- Manpower Programming. A process that puts a manpower plan into operation focusing on the development of human resources. The process defines the specific educational and training programs; the identification and utilization of teaching, training and instructional techniques necessary for carrying out human development; and the application of valid and reliable techniques for appraising the results of the educational and training programs (Patten, 1971, p. 33).

With these definitions as so-to-speak "ground rules," let me now present educational viewpoints and ultimately a viewpoint that I believe to be realistic, but which some have indicated is too idealistic.

Many people take on extremist viewpoints. For example, two that came to mind, although differing significantly with respect to time, are very much in agreement.

First, Kenneth Boulding, an economist of high regard, who infiltrated the educational realm in Pennsylvania last summer, states: "I find the whole manpower concept repulsive, disgusting, dangerous, fascistic, communistic, incompatible with the ideals of a liberal democracy and unsuitable company for the minds of the young" (1972).

Second, Seneca, a Roman patrician from Biblical times, seems to agree with Boulding by stating: "I respect no study, and deem no study good; which results in money-making."

A somewhat opposite viewpoint was taken by Eric Walker in 1966 when, in assessing the 1966 Pennsylvania Master Plan for Higher Education, he stated: ". . . the biggest change I would have made would have been to examine the needs of the State for trained people so that we could assist the industry which eventually will be called upon to pay the taxes for a large part of our educational enterprise."

Further support was offered by Mina Rees in discussing the plight of American universities when she stated:

> If I am right in my belief that there should be greater responsiveness between colleges and universities to the needs of their regions and greater specialization in their programs, it may be that public funds should be provided to an institution only after a judgment on the suitability of institutional or program objectives has been made at the State or regional level.

These two positions that somewhat strongly favor the utilization of manpower research and information in program planning and decision-making are by no means exhaustive; however, by no means are those two positions condemning the manpower planning approach exhaustive, either. It is my belief and the belief expressed by others that it will continue, possibly indefinitely, but it is also my opinion that educators cannot continue to ignore the fact that this information can be helpful in making meaningful educational decisions.

Some economists and planners have stated a middle-of-the-road viewpoint of the manpower-requirements approach, this being that alone it cannot answer the question of how much is needed or what type is best, but that it does provide <u>useful guides</u> to the desirable structure of whatever educational expenditure is decided upon, not only meeting the needs of the labor market per se, but of the individual student as well.

I would like at this point (following my smorgasbord style) to interject a quote from the Newman task force report on data and decision-making, for remember that the ultimate output from the manpower research, to which we are addressing ourselves, is data in all its glory. The task force report relates the following:

> The need for data about postsecondary education is the same as the need for facts in any other area where people make important decisions. We need to know the consequences of our choices.

Good data will not guarantee that we will make the right decisions even if social scientists have analyzed its implications in great detail. Some of our goals are just too difficult to quantify.

However, good data can at least assure us that when we think we are deciding on the basis of the facts, they are facts and not mere myths and prejudices.

Now, I would like to dwell in a brief fashion on some problems involved in manpower research and describe certain examples of data on national and state levels.

Manpower research is a very difficult task particularly in the context of educational planning and programming. The difficulty lies not only with the ability to manipulate the data and observe today's manpower situation but also with the ability to predict future outcomes of various skill demands. The demand for a particular skill changes in relation to the interactions of economic, political and technological factors in our society.

For example, it is agreed upon by many that it is tricky to apply national statistics and projections to state or local situations. But sometimes even national projections are off-target because seemingly extraneous factors could not be foreseen. The carbonated beverage industry offers a classic example. In the 1930s, industry economists projected beverage consumption and the need for glass bottles far into the future. They were right about consumption, but the bottles? Apparently, no one thought about metal containers (AVA Journal, 1972)!

In spite of these potential difficulties, national labor market information can give us the basis or starting point in attempting to better understand specific markets and future job opportunities.

Let us briefly examine certain data and trends for the 1970s-1980s using national and state data. The U.S. Department of Labor indicates that there will be nearly 16.5 million more jobs in 1980 than in 1970. They add that by 1980, 101 million Americans are expected to be in the national labor force, approximately 17 per cent more than the 86 million in 1970. In Pennsylvania, the Department of Labor and Industry estimated that in 1970, approximately five million individuals will make up the civilian work force and that by 1980 they estimate 5.5 million, an increase of approximately 8.6 per cent.

What about specific jobs or occupational openings? Will there be new jobs or occupations?

The national data indicate that the jobs will be pretty much what they are now. This is based largely on a continuation of past trends modified by such changes as can be anticipated.

By 1980, there will be an actual decrease in the need and opportunity for nonfarm laborers. There will be fewer places in the labor market for the unskilled, and it seems as if there is no choice but to do whatever is necessary to provide some kind of skill training to everyone.

The biggest expansion will be in the service industries. The second largest growth industry is government. Most of the growth will take place at the municipal and state levels.

Modern farming is highly mechanized and many farm jobs are in other growth industries (service, manufacturing) related to food and raw material production. The number of farmers (farm managers and farm operators) will decrease by .5 million during the '70s following the trend of the past decade when their numbers decreased by two million.

While national statistics suggest the employment future in general, they do not necessarily describe any given local situation. Where a particular industry or occupational field is down, according to national statistics, it could be thriving in certain labor market areas within a state. Family farming, for example, is still big in many areas and there is a need for basic farm skills, even though the total number of farm workers will continue to dwindle. Nevertheless, many local industries, especially those that are part of a major corporation, will follow the national pattern (AVA Journal, December 1972).

The annual manpower planning report for fiscal 1974 by the Pennsylvania Department of Labor and Industry indicates the following occupational trends for 1970-1980: A gradual, if not substantial, increase in per cent distribution for white collar occupations and a corresponding decrease in blue collar occupations that has taken place since 1940 will continue. The white collar components showing the greatest increase during the 1940-1970 period were the professional, technical and kindred workers group, whose distribution increased from eight per cent to 13.5 per cent of total employment and the clerical and kindred group that increased from 10.4 per cent to 17 per cent. Further growth is projected for these categories through 1980.

This is just a small sampling of data and information available. Granted, in some cases it is hard to understand or interpret in ways that we in education can meaningfully use. But I believe that in this past decade and in the present one, steps are to be taken to change that picture. The current economic plight of the nation, this state and the educational institutions has caused those individuals responsible for labor market information to attempt the development of better and more usable manpower data.

I would like to conclude by saying that the task ahead is a difficult one if educational planners and decision-makers do not recognize and use manpower information, for we can then expect oversupplies and undersupplies of trained individuals, and without question the labor market of 1970-72 revealed this.

And I believe by your presence here today, and hopefully our collective efforts in the future, that we will be able to prevent this.

# A COMPREHENSIVE SUPPLY/DEMAND MODEL FOR EDUCATION

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## Overview

In seeking to provide relevant manpower data which can be used for educational program planning at the state, regional and local level, the Pennsylvania Research Coordinating Unit for Vocational Education and the Bureau of Vocational Education have prepared various reports aimed at satisfying the data needs of planners and decision-makers. These studies originated from efforts resulting in the Pennsylvania Vocational Education Study (1). Included in this publication was a manpower supply/demand model for projecting manpower needs. The framework for the model was built on the identification of industry and population characteristics over time (refer to Figure 1). Incorporated within it was a modified version of the manpower demand model as developed by the Bureau of Labor Statistics, U.S. Department of Labor (6), and a supply model which sought to determine to what extent graduates from various training agencies filled the demand for trained manpower. Information on the supply and demand for manpower was provided for over 160 occupational classifications. One of the shortcomings of this effort was that the information was only available on a statewide basis.

Subsequently, efforts by the RCU to expand this manpower planning information framework resulted in the publication by James F. McNamara and Stephen J. Franchak entitled Planning Vocational Education Programs in Pennsylvania: Guidelines for the Use of Labor Market Information (2). Included in the publication was manpower supply/demand information for the state, the 13 major labor market areas and three selected smaller labor market areas in Pennsylvania, plus selected statistics on graduates by county, by training agency and by occupation (refer to Figure 2). An updated version of this report was prepared the next year by Stephen J. Franchak and Nancy L. Brumo (3). A further revision of those publications is anticipated in the near future.

## Present Plans of Supply/Demand Model

In developing the initial supply/demand model, it was evident that many data elements contained limitations which restricted the output for meeting local planning needs. For example, occupational employment and demand data was only available for selected areas (major SMSAs) and was based on 1960 census data. Thus, it was decided that when the supply/demand model would be updated using 1970 census data (the primary data base for projecting occupational employment), improvements would be incorporated which would eliminate some of the major limitations and reinforce certain assumptions which would provide for a higher degree validity in the manpower data.

### Improvements in the Supply/Demand Model

#### a. Adjusting Supply Data

Initially, it was assumed that a graduate from a particular program would enter the occupation for which trained. Thus, for example, it was assumed that a graduate from an auto mechanics program would enter the occupation--motor vehicle mechanic.

Figure 1

Initial Conceptual Framework for the Development
of the Manpower Supply/Demand Model

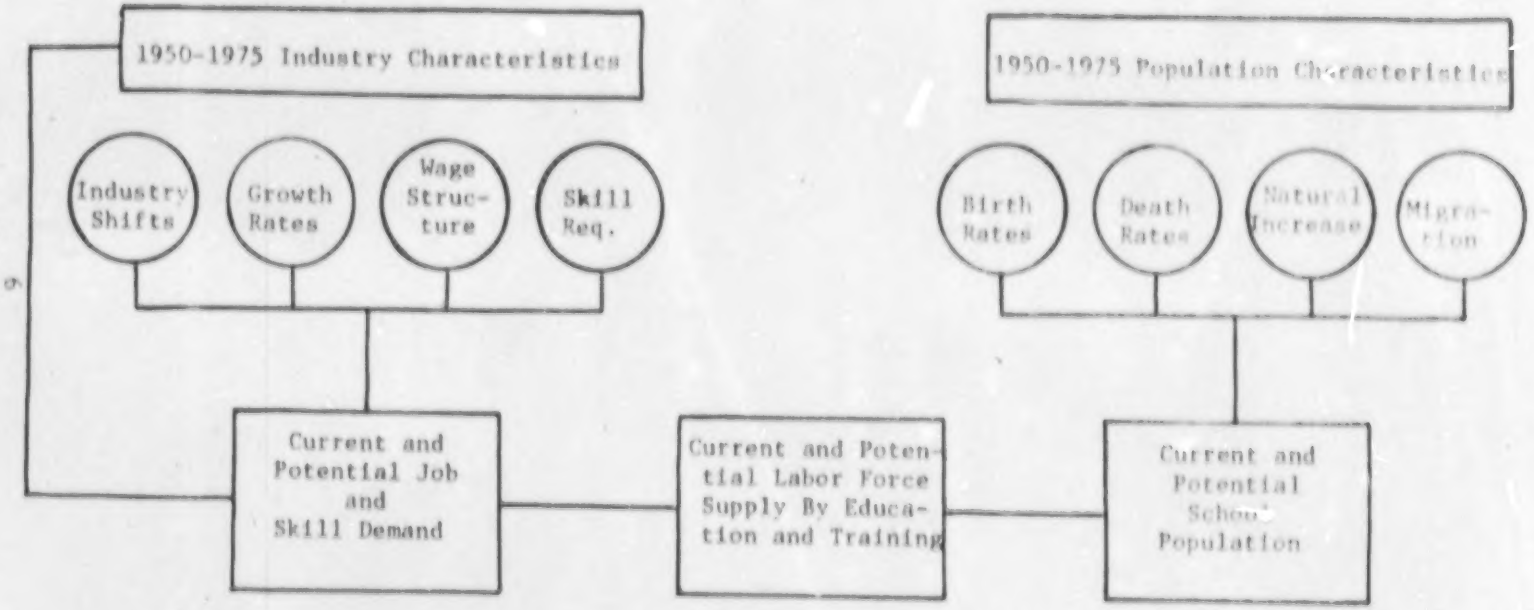
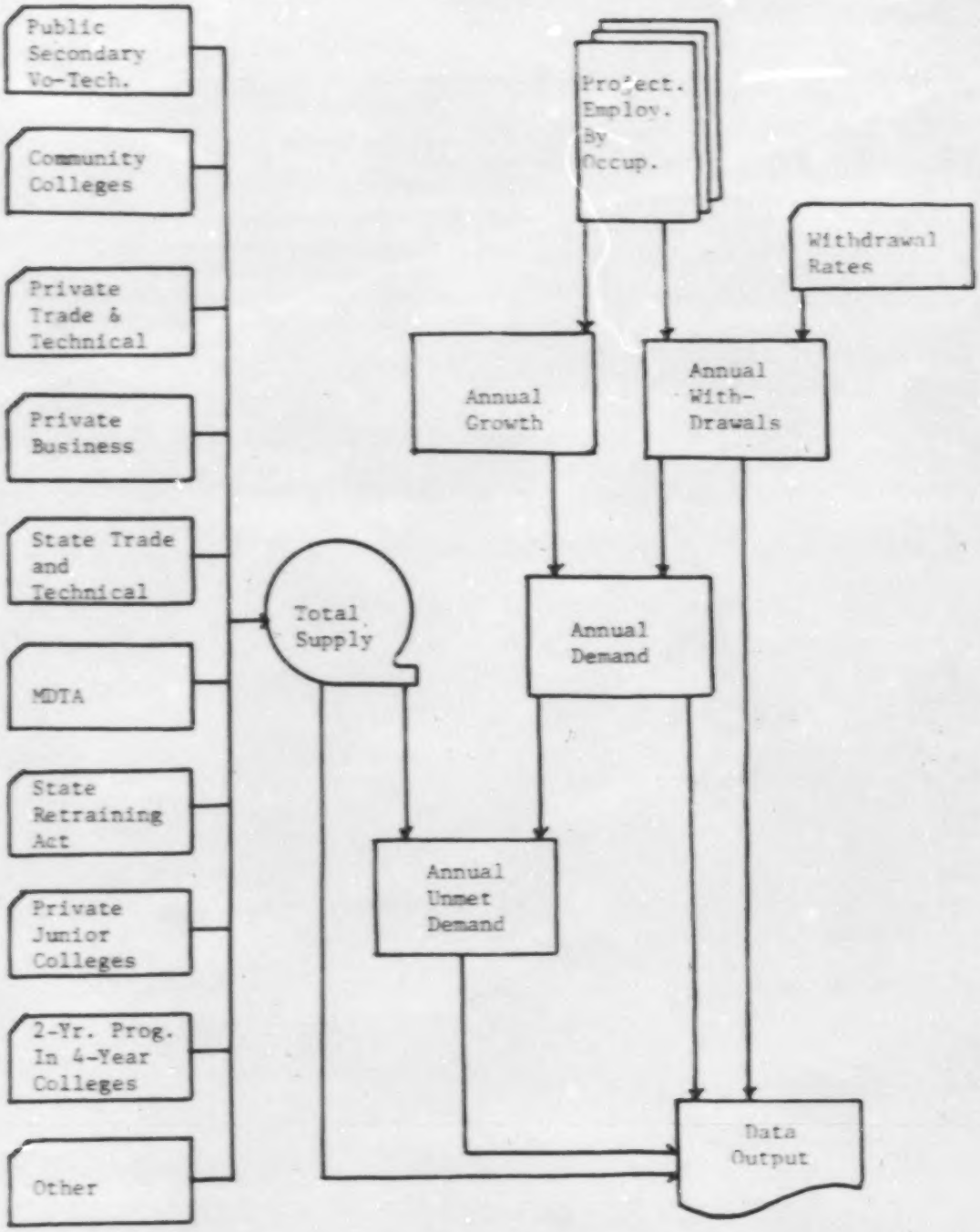


Figure 2

Flow Chart
Initial Supply/Demand Model



This assumption was made because no information was available as to the per cent of the graduates by program and institution who enter the labor force and what per cent actually find employment directly related to their program of study. In an effort to overcome this limitation, the Pennsylvania Department of Education, with the assistance of The Pennsylvania State University, Department of Vocational Education, developed a number of instructional program/occupation matrices by institution type based on follow-up surveys of graduates (4, 5). These matrices permit an initial adjustment of the potential supply in terms of the labor force participation rate by program and institution and further permit a determination of the number of graduates by program and institution entering a particular occupation. At present, instructional program/occupation matrices have been developed for secondary vocational-technical program graduates and for postsecondary vocational program graduates (community colleges, two-year programs in four-year institutions and private business colleges).

b. Occupational Withdrawal Rates

Recognizing that between one-fourth to two-thirds of the total demand for skilled manpower (depending on the occupation) is attributable to occupational withdrawal for reasons such as death, retirement or, in the case of women, leaving the labor force due to marriage and/or the birth of a child, a major effort was made to develop more accurate withdrawal rates for individual occupations. The methodology used in developing these rates is similar to that outlined in Tomorrow's Manpower Needs, Volume I (6). Trend line analysis was used to estimate withdrawal rates over time for selected occupations. These rates were developed for the years 1950, 1960 and 1970 (7).

c. Projected Employment by Occupation

In order to develop projected employment information to 1980, 1985 and 1990, the RCU entered into a cooperative project with the Governor's Office of State Planning and Development under contract with the National Planning Association. The outcome of this project was the development of data concerning projected employment and annual average growth by occupation by industry for Pennsylvania and its major labor market areas. This project updates the occupational employment projections developed in the 1969 Vocational Education Study (1).

d. Additional Sources of Supply

In developing the initial supply/demand model, it was recognized that the 10 sources of supply were by no means exhaustive. The basic limitation was a lack of information on other sources. In an effort to overcome this limitation, exhaustive research was conducted. In addition, the cooperation of other Commonwealth government personnel was solicited. As a result, information will become available on the supply to the labor force resulting from military returnees and on dropouts from high school. Also, as a result of efforts by Dr. Toombs of The Pennsylvania State University, the Bureau of Higher Education Planning and the Division of Research, yearly follow-up surveys of baccalaureate degree graduates in Pennsylvania are being planned, thus making available information on a major source of trained manpower for those occupations requiring a baccalaureate degree.

e. Other Improvements

In order to aid local educational planners in their systematic analysis of the occupational information supplied by the revised supply/demand model, an evaluation

of the outputs in the form of "trade-offs" has also been incorporated (refer to Figure 3). This was done so that a comparative analysis of the occupational information would facilitate the establishment of priorities for the local program planner. The basic idea was developed as a part of the systems approach to vocational education program planning (1: 212, 232).

# SUPPLY DEMAND MODEL FOR VOCATIONAL EDUCATION PLANNERS

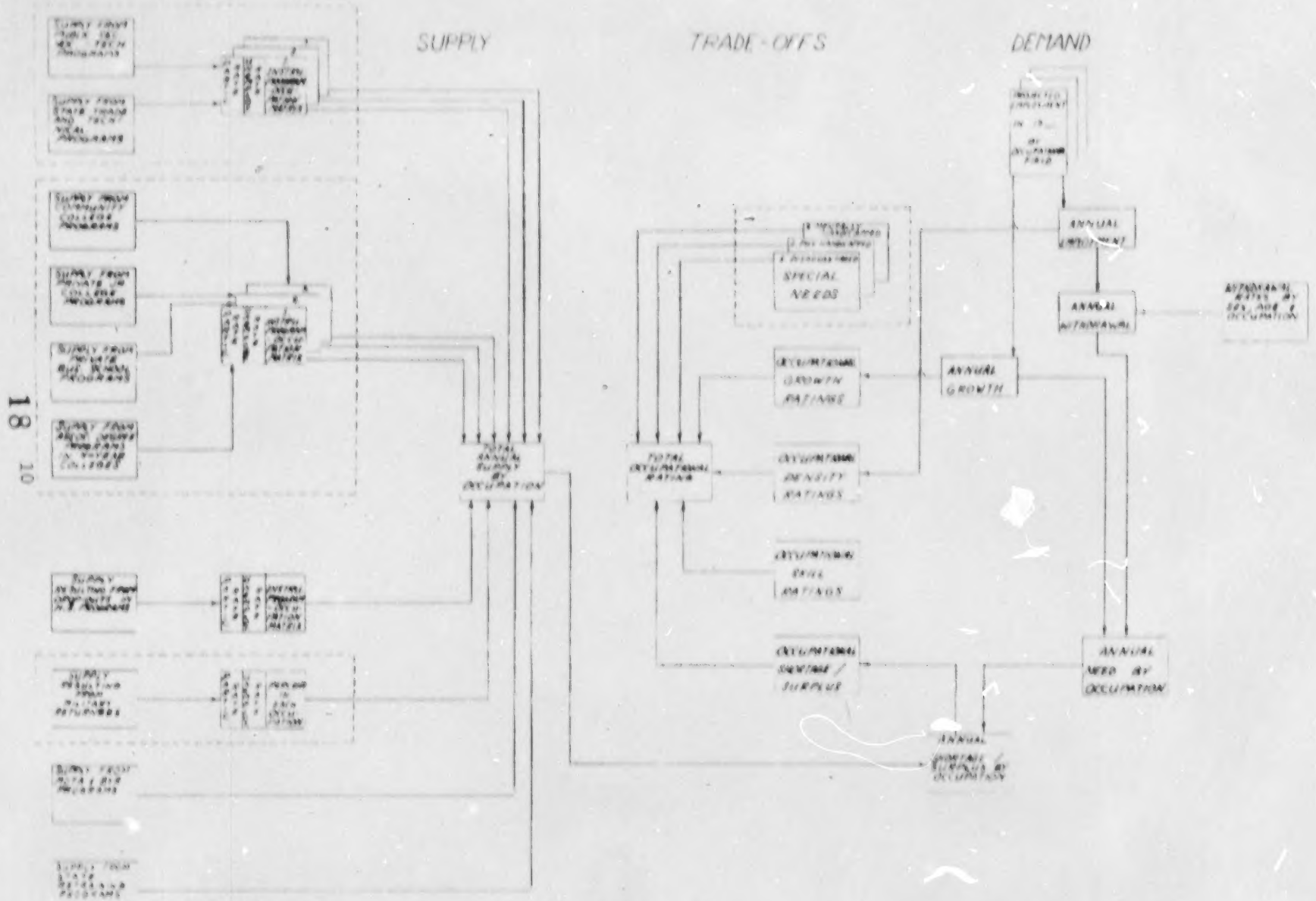



Figure 3

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# MANPOWER RESEARCH AND INFORMATION: FEDERAL BUREAU OF LABOR STATISTICS VIEWPOINT

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## Summary of Remarks

Over the years, economists, manpower analysts, educational planners and others have expressed a need for current data on employment by occupation, for projections of future manpower requirements by occupation and information on the current and prospective supply of workers by occupation. Although such data have been provided for a number of years at the national level and for a limited number of states and areas, they have never been considered adequate to meet the needs of the preponderance of users. Furthermore, the way in which these data have been collected, the occupation classifications systems used and the methodologies for developing manpower projections have varied significantly.

Several pieces of federal legislation in the '60s and the Comprehensive Employment and Training Act of 1973 point to the need for vocational training programs to reflect current and long-range needs for trained manpower. Such an objective recognizes the worth of the nation's most valuable asset--its human resources. In recent years unemployment among scientists and engineers and currently the oversupply of teachers exemplifies the need to assess the effects of changes in federal expenditure programs on manpower supply and demand. Systematic and intelligent action to deal with imbalances between the demand and supply of workers for specific occupations must be based on projections of manpower requirements and resources, nationally and for states and areas.

The Bureau of Labor Statistics has recently developed several programs to meet these needs: the Occupational Employment Statistics Program, Interim Manpower Projection Project and the National/State Matrix System. The first of these, the OES Program, is currently operational in 26 states and four more will join this summer bringing the total to 30. All indications point to Pennsylvania as being one of the four new states.

Briefly, the OES Program is a mail survey program designed to produce estimates of occupational employment by industry, covering the entire nonagricultural, wage and salary work force. The data generated by the program will be valuable in planning and developing manpower training programs, providing realistic vocational guidance information and aiding state and national manpower projections and occupational outlook studies. In this study, most industries are surveyed on a two-year cycle. The frequency of resurveys will be adjusted so that fast changing industries will be surveyed more often than those changing slowly. The statistics generated from these surveys will measure the growth of occupations and the changing occupational structure of the labor force in states and areas. They are also needed to develop a base for calculating job vacancy rates or unemployment rates by occupation. The collection and analysis of occupational composition patterns of industries will show how different industries and different plants in the same industry employ workers in various skills and the factors affecting occupational composition and trends over time, which reflect technological and other changes. Such information will be essential in projecting manpower requirements by occupation, the needs for which are specified in legislation for vocational education and manpower training. Information on future employment opportunities is used in vocational guidance. The

occupational composition of various industries is also needed to estimate the manpower implications of proposed new government programs such as those in the fields of housing construction, pollution control, health or urban mass transit. Local employment service offices need information on the occupational patterns of industries to locate employment opportunities for applicants. Finally, occupational employment and patterns data have many uses in analysis of labor markets within and outside the firm and in industrial management.

Another program started last year and now coming to a close is the Interim Manpower Projections Project. This project was set up to provide interim occupational demand data until the Matrix System would become operational in mid-1974. The purpose of this project was to provide projections of industrial and occupational manpower requirements by state and major substate economic areas. In Pennsylvania, data is or will be available for the state, Philadelphia, Pittsburgh and eight other Standard Metropolitan Statistical Areas. While using modified methods, the project was developed in a manner consistent with other BLS programs presently developing occupational information.

The principal interim projection method developed by BLS is based on an abridged matrix program. Supplemental procedures, using available occupational projection information in combination with census and local office information, were also used. The projections were prepared by two separate processes. In the first process, projections of occupational requirements were prepared for all states and large SMSAs using the "Method A" procedures outlined in Volume I of Tomorrow's Manpower Needs. These estimates cover both growth and replacement requirements. The second process involved the preparation of smaller area projections developed using the state projections as controls. This was done using "Method B" from the same publication.

The projections of occupational demand, covering both growth and replacement, consist of up to 440 specific occupations by state and major labor market and/or economic areas. The output from this project is set up in three tables. Table 1 shows industry employment data (number and per cent of total employment) for 1970, 1975, 1976 and 1980. Table 2 shows the same data by occupation. Table 3 shows total job openings for 1976 by occupation, first as a number then as a per cent of total job openings and also as a per cent of 1976 employment in that occupation. The final columns show openings due to growth and due to deaths and retirements.

The short-run occupational projections for the years 1975 and 1976 have been computed by linear interpolation of the 1970-1980 trend. Therefore, considerable care must be taken in using the 1975 and 1976 estimates since they do not attempt to measure cyclical movements in the economy. However, they should provide valuable information to those interested in the average annual industrial and occupational manpower requirements during the '70s.

The final program is the one which is the bulkhead of all our projections and is called the National/State Industry-Occupational Matrix System. The first phase will become operative some time this summer. The BLS and the Manpower Administration, in cooperation with all the state employment security agencies, is developing a set of 51 industry-occupational matrices consistent in format, content, coding structure, etc. with the BLS national matrix. A multipurpose computer system for using these matrices for a number of research and operational purposes, including the development of projections of occupational requirements, is included in this program.

In order to develop the state matrices, the MA purchased from the Census Bureau a series of computer tapes giving occupations by industry information for all states and the District of Columbia. When this system is completed, each state will have a 1970 and a projected 1980 matrix for each class of worker (private wage and salary, federal government, state government, local government, unpaid family workers and self-employed workers). The listings generated will cross-classify over 440 occupations into over 220 different industries.

Since the original 1970 matrices are based on census data, they will essentially be on a persons by place-of-residence concept. The systems design will, however, enable the states to insert with ease any data they wish, including data that will enable them to convert the matrix to a job by place-of-work concept through inclusion of OES or other relevant data. All the state matrices will conform to the national matrix. Also, as part of this system, the MA has purchased from the Census Bureau a tape showing the age distribution of the employed population by occupation and sex for all states. BLS is calculating age-specific rates using standard working life tables for 1970 and applying these rates to the census data to calculate occupation-specific separation rates for each state. These separation rates may be used by the agencies to estimate replacement demand for workers who die or retire.

The state agencies will be provided with the computer software to manipulate the base period state matrix in order to insert additional data, update the matrix, use it for projections, develop SMSA or other area matrices, etc. These state matrices will work in conjunction with and/or supplemental to the new OES Program mentioned earlier.

An experimental state matrix was just run for the states of Maine and Pennsylvania using a modified "Method B" from Volume I of Tomorrow's Manpower Needs. A few sample sheets of what this looks like are available. However, the complete 1970-1980 matrix should be available later this summer.

Finally, I would just like to mention a few proposals that are currently being considered. The first is a proposal to do further research on local area projection methods, including the integration of the OES survey data with the National/State Matrix System. The program will test procedures and techniques for doing small area projections. Another proposal calls for the development of substate matrices using primarily data from the 1970 Census of Population. All of these substate matrices would be updated for 1973 and finally projections would be developed. Another proposal involves updating of the state matrices to 1973.

Although important advances have been made in recent years in the development of a Labor Market Information System that is conceptually consistent, provides greater occupational, industrial and geographical detail, we realize that this is only the beginning. While the level of expertise has risen, so have the problems. Projections of manpower requirements for small areas and for short-run periods fall into an area where manpower expertise is limited and available data is in short supply. Therefore, BLS is researching, testing and implementing, where possible, new techniques and procedures necessary in accomplishing these goals.

# SOME IMPLICATIONS FOR EDUCATORS OF THE FINDINGS IN THE REPORT: A STUDY OF PHYSICIAN MANPOWER SUPPLY AND DEMAND IN PENNSYLVANIA

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During the recent past, the United States' medical system has been subjected to a rising volume of complaint due to the following factors:

- Rapidly mounting costs.
- Failure to provide care to rural and inner-city populations that is equivalent to that received by suburban residents generally.
- Neglect of the emergency care aspect of medical practice.
- Failure, earlier in the century, to increase the production of physicians in proportion to population growth.
- An apparent shortage of physicians relative to demand resulting from the advent of new medical delivery innovations such as medicare and medicaid.

Few writers in this area deny that there are problems. The solutions proposed are many and varied and range from modification of our present system to the proposal of very different medical delivery systems than we now have.

Some have proposed sharp increases in the production of physicians by enlarging our medical schools. Even if this were the solution, it is, of necessity, an expensive, long-term expedient since physicians are expensive to educate and it takes six or more years to train and educate a physician.

Most writers have, in fact, emphasized the need for an increased output of physicians and/or paraprofessional medical personnel. In so doing, however, there is a possibility that we would simply create an overall surplus of physicians without actually redressing the more basic problem of physician maldistribution.

All evidence, including that in my own study, points to the probability of a surplus of specialists and a continued dearth of basic care physicians in 1980 and later. Indeed, the surgical specialties such as general surgery may already be in a surplus state in Pennsylvania.

In effect then, we simply do not now, nor will we soon, have a sufficient number of general practice, family practice and internal medicine specialists to meet our citizens' medical needs. In actual fact, the number of basic care specialists is rapidly diminishing, despite a rising population, due to the precipitous loss of general practitioners who are nearing an average (median) age of 60 years without a compensating growth of internal or family medicine sufficient to counterbalance their decline. Only the large projected increase in the output of osteopathic physicians during the coming decade seems likely to ameliorate this situation in the immediate foreseeable future.

Even if we were now producing adequate numbers of basic care physicians, we would still be possibly in a situation where our citizenry in many parts of the

state would be receiving inadequate medical care. We have not only been producing too many specialists relative to the basic care area but also our physicians have been paralleling the migration patterns of the general population. In other words, they have been avoiding or fleeing from the rural and inner-city areas of the state and setting up practice in the affluent suburbs.

This problem of geographic maldistribution is not subject to an easy solution, not even by such expedients as loan forgiveness programs or periods of government service in rural America. It is really, basically, a question of how does one get a physician to remain in a rural area even if such programs are able to induce him to practice there for a given, limited period of time.

Certainly, the experience of the Sears Foundation, among others, does not encourage us to believe that programs designed to encourage practice in rural areas will be successful unless we change our approach drastically. The Sears Foundation found that physicians in their program left their solo rural practices. They, in fact, did so in such large numbers that the foundation had to abandon its program of financially assisting rural communities to build small, well constructed and equipped offices to attract physicians. The foundation also aided the recruitment effort by providing financial aid to the physican in setting up his practice.

According to the foundation, physicians left their practice in these communities for the following reasons:

- Isolation from other physicians, both socially and professionally.
- No time for, or access to, facilities to continue and upgrade their medical training and skills.
- The desire to specialize.
- The dislike of the family or of the wife for the limitations of small town life, socially and educationally.
- The lack of readily accessible hospitals for intensive care, requiring time-consuming travel on their part for patient visitation or an abandonment of their more interesting and challenging cases to colleagues in distant hospitals.
- The sheer burden of night calls, the lack of vacation time due to being the sole provider of medical care for the area.

It would seem likely then that the concept of solo practice in rural areas is simply no longer a viable one and that we will have to develop a medical delivery system for rural areas that will meet the legitimate needs of the physician and his family if the problem of geographic maldistribution is to be solved.

A strategic location of group practice-oriented health care centers in rural areas would seem to be a possible answer where four or more physicians could provide a combination of expertise and mutual consultation that no single physician could aspire to. In this way, the physicians felt needs for professional collegiality, for the freedom to pursue continued education, for greater freedom from an unremitting burden of night calls and for vacations taken without feeling that one has abandoned one's patients can be readily met. The physicians in such a

a group practice can share the burden of night calls, cover one another for vacations, attend conferences and the like, and, in addition, provide mutual consultation and assistance to one another as needed.

Properly located, such centers would also include better educational and social opportunities in the community for the physician's family along with ready access to larger metropolitan areas for shopping, etc. In addition, there is the possibility of the physician having better access to hospitals especially if we provide such things as helicopter/ambulance services. The more isolated areas would be served by paraprofessionals under their supervision using modern communications.

This, then, seems to be the essence of my findings--a continuing need for physicians but primarily for basic care physicians in the rural areas of the state. There is, furthermore, a need for delivery systems that are appropriate to the needs of the rural and urban physician as well as the citizenry of such rural and urban centers.

Projections of future need for physicians, such as undertaken for this study, are, of course, not easy. This is true for a variety of reasons. Fortunately, the primary problem of obtaining detailed data concerning the physicians of Pennsylvania did not prove to be an insuperable one due to the efforts made by the American Medical Association to keep track of every physician in the United States from the time he or she graduates from medical school or enters the country as an immigrant.

The condensation of my report (1) that you have in your hands is a very brief version of a highly detailed 300-page report (2) but it is my hope that it will, in general, meet the needs of most of those attending this symposium.

Rather than simply attempt to reiterate the detailed findings of the report, I thought that I would now address myself to what I believe are its implications for those of you who are involved in higher education at the undergraduate premedical level.

The report indicates three basic facts that must be faced, I believe, by the young premedical student and by the schools that offer a premedical curriculum.

First, the fact that physicians are in demand and will continue to be in demand for the next decade at least. The nature of that demand will be increasingly away from the specialized areas of medicine due to a probable surplus of specialists, especially in surgery-oriented specialties, and markedly toward such basic care-oriented specialties as family medicine, general practice, internal medicine and pediatric medicine. This means that students will have to be encouraged to consider medical practice in rural and urban areas that are now lacking in adequate medical personnel and facilities to an alarming degree.

Second, that the rise of the Health Maintenance Organization, coupled with prepaid and/or universal medical insurance, will have a marked impact upon demand since many will be getting medical treatment they previously did not get due to the cost barrier. The National Health Insurance will undoubtedly increase the demand for physicians to some degree, although the HMO seems to be capable of reducing the resulting demand due to its greater efficiency.

Your students are, therefore, more and more likely to live or work in a group practice rather than a solo practice setting and in a rural or urban setting rather than in a primarily suburban setting.

The third fact is that the demand for medical education now far exceeds the capacity of our medical schools to meet that demand. As a consequence, the medical schools are now and are likely to be increasingly selective about the students they will admit. Special efforts may well be made to recruit the female, the minority group member and the rural student. There may be more emphasis on admitting more residents of the state in which the medical school is located. Even so, the student will find acceptance difficult. To make matters worse, an increasingly large proportion of our freshman classes are indicating medicine as a career goal. As a result, the growth in applicants seeking admission has far exceeded the growth in the number of places available. As a consequence, the criteria for admission are becoming increasingly stringent as to verbal intelligence, quantitative ability and scientific knowledge and aptitude.

Only the exceptional student with a very high grade-point average in his premedical science and math curricula is likely to be accepted. In 1971-72, for example, only 13,500 out of 35,000 applicants, or 38 per cent, were accepted. Between 1961 and 1969, the first-year entrant scores on the medical college aptitude test rose 19.51 per cent with regard to verbal ability scores, 18.82 per cent with regard to quantitative ability scores and 16.34 per cent with regard to science knowledge and ability scores. In other words, the successful applicant of 1961 would be, to a large degree, the unsuccessful applicant of 1969.

You, therefore, will have to devise counseling strategies to prepare students for the possibility of rejection by the medical schools and to plan for alternative futures in other health-related or science-oriented areas where their interests and training can be made applicable. Certainly, the premedical curriculum should be examined carefully with an eye to making your graduates more flexible if an acceptance is not received by them. Finally, may I point out, you should be aware that preparation of graduates for paraprofessional careers in medicine, such as that of physician's assistant, will become increasingly important and may well constitute one of the important alternatives for your rejected graduates.

I sincerely hope that what I have been able to say in this short talk will be of value to you. If you wish to speak to me privately at a later time, please do not hesitate to do so.

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# DENTAL MANPOWER SUPPLY AND DEMAND IN PENNSYLVANIA

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People seem to give little thought to the need for dentists and even those who study professional manpower do not seem to comprehend the full need for dentists.

Writing in Esquire Magazine, February 1973, Gerald Astor said:

> America's teeth generally are in a mess, and despite their rising prices dentists look forward to a limitless future of opportunities. There are millions upon millions of cavities out there. Some 25,000,000 Americans lack a single homegrown tooth and more than 40,000,000 people have never seen a dentist. . . . Among every hundred soldiers (inducted into the army, age 17-25) there were 600 teeth to be filled, 112 to be pulled, 40 bridges required, 21 crowns necessary and 19 who needed either a partial or a full denture.

Some may say that Americans neglect their teeth because dental costs are so high. But Parade Magazine reported April 29, 1973: "One reason dental costs are so astronomical in this country is that there is a shortage of dental manpower, especially in rural areas."

There is a shortage of dental manpower in the nation and in Pennsylvania in terms of dental care needs of the people.

Let's examine dental manpower nationally and see where Pennsylvania fits into the picture.

In 1968 the U.S. Bureau of Labor Statistics estimated annual openings for dentists to 1980 as 4,900. Yet, the number of dental graduates in 1968 was only 3,457, 1,443 fewer than the estimated demand and in 1980 the projected number of graduates will be 4,450, 450 fewer dentists than needed. In the 1968-1980 period, there is an estimated shortage of 12,376 dentists, an annual shortage of almost 1,000 dentists in the United States.

## Some Indicators of a Dental Manpower Shortage

- It takes a long time to get a dental appointment. Data from the dentists provided by the American Dental Association indicate an average waiting time of 13 days but 47 per cent of dental patients waited two to six weeks and eight per cent waited six weeks or more.

- Dental costs have advanced more rapidly than personal income. From 1950-1970, dental expenditures in the nation increased by 362 per cent, while personal income increased by only 209 per cent, a differential of 153 per cent in favor of the dentists.

- From 1967-1970, the number of patients per dentist in the United States per year increased from 1,292 to 1,485, 193 patients, a 15 per cent increase in four years indicating an increasing workload per dentist.

Nationally, the dental manpower situation improved in 1960-1970 with the population per dentist declining from 1,718 to 1,697, 21 fewer people per dentist. But in Pennsylvania, the population per dentist increased from 1,603 in 1960 to 1,750 in 1970, 147 more people per dentist indicating an increased workload of 12.1 per cent. In fact, from 1960-1970, the population of Pennsylvania increased 4.2 per cent but the number of dentists decreased from 7,063 to 6,739 or 4.6 per cent, representing a combined negative impact on dental care of 8.8 per cent.

Distribution of Dentists in Pennsylvania

On this map of Pennsylvania, showing counties and Higher Education Planning Regions, we may note the population per dentist and the number of dentists in each county (see Figure 1).

Three counties have one dentist each:

| | |
|---|---|
| Juniata . . . . . | 16,712 people per dentist |
| Forest . . . . . | 4,926 people per dentist |
| Sullivan . . . . . | 5,961 people per dentist |

Two counties, Philadelphia (1,347) and Allegheny (1,139), have a total of 2,486 dentists, 36.8 per cent of all Pennsylvania dentists (6,739) in 1970 and a ratio of more than 300 people per dentist, lower than the state average of 1,750.

Twelve counties have an impossible population per dentist. Snyder, 3,252; Juniata, 16,712; Perry, 7,154; Fulton, 3,592; Greene, 4,010; Clinton, 3,429; Elk, 3,424; Forest, 4,926; Potter, 3,279; Tioga, 3,608; Sullivan, 5,961 and Susquehanna, 3,434. Increased per capita buying power could probably bring more dentists to these areas. The alternative may be financial support of dental care by government.

Dental Manpower Demand: Growth in Number of Dentists

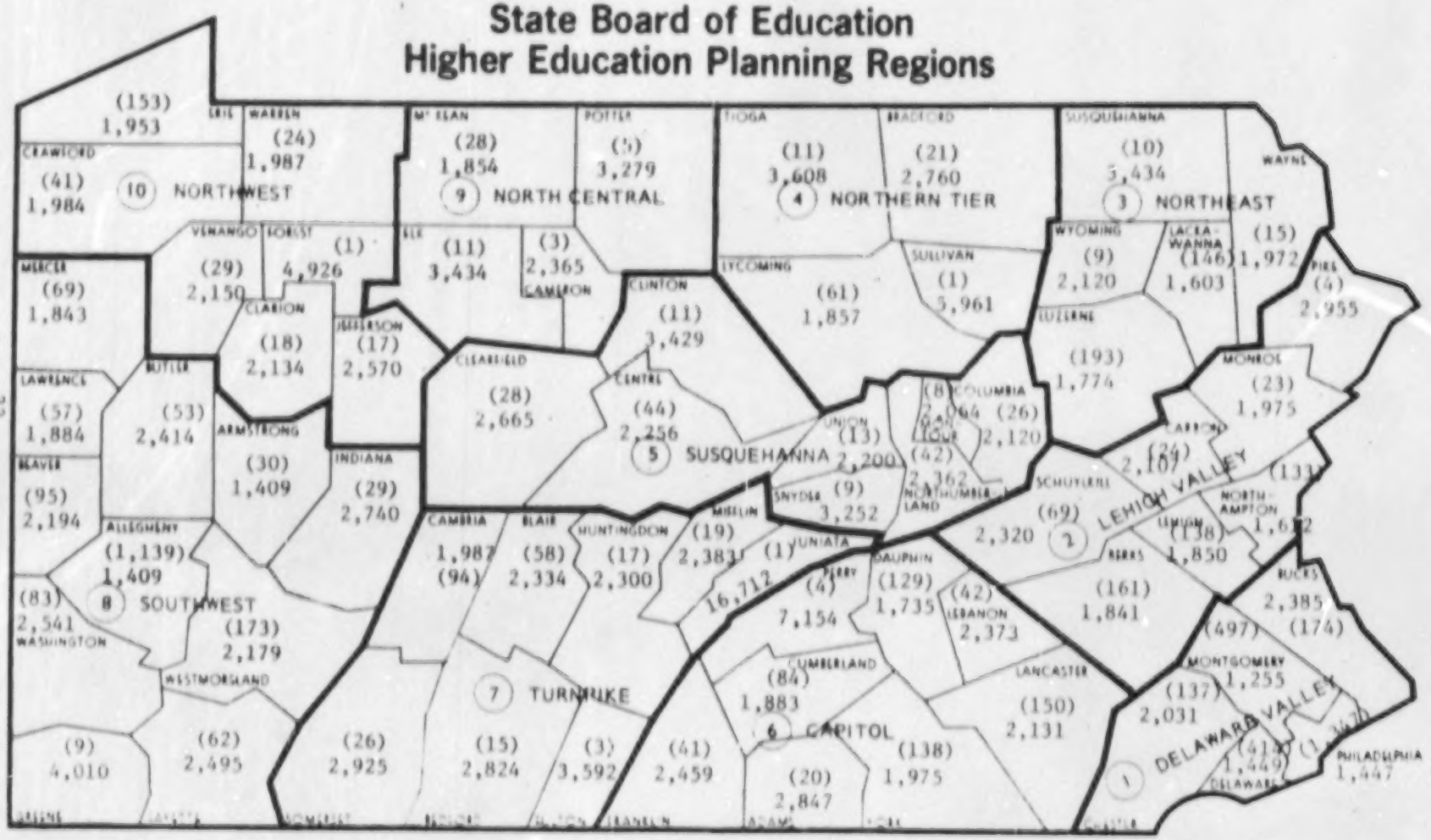
- Growth in the number of dentists in Pennsylvania to reach to projected national average of one dentist for every 1,620 people in 1980 will require the equivalent of dentists to serve 876,070 people. (1,750 - 1,620 = 130 people; 130 x 6,739 dentists = 876,070 people) In the Middle Region of which Pennsylvania is a part, a dentist serves an average of 1,388 people per year. To serve the equivalent of 876,070 people would require 631 additional dentists. (876,070/1,388 = 631)

- Growth in the number of dentists is also required to serve the increase in population, 1970-1980, a projected 362,272 people. This would require 261 additional dentists. (362,272/1,388 = 261) Total for growth, 892 dentists.

- To reach the national average for dental specialists for 1970 population and population growth, 1970-1980, Pennsylvania will require 128 dental specialists, about 13 per year, and since many will start on a part-time basis, it is estimated that three dentists per year will be needed to take up the general practice given up by those becoming specialists. Total number of dentists needed for dental care equal to the national average is projected as 920, 1970-1980, or 92 annually.

Figure 1

Population Per Practicing Dentist by Counties in Pennsylvania, 1970, and Dentists in Each County



## Dental Manpower Replacement for Withdrawals

Replacement includes retirement, death and disability. Examination of the data in the study indicates that about 29 per cent of the dentists practicing in 1970 will be withdrawals in the 1970-1980 period with a replacement rate of 2.94 per cent per year. The number of dentists needed for replacement is projected as 1,980 during 1970-1980. Total demand growth and replacement to bring dental care up to the national average is projected, therefore, as 2,900 dentists, 1970-1980.

Greater use of dental assistants could increase the productivity of dentists by as much as one-third. This increased productivity could be used to provide more services or to reduce the number of dentists required.

## Dental Manpower Supply in Pennsylvania

Dental manpower is supplied by three dental schools--University of Pennsylvania, University of Pittsburgh and Temple University. In addition, about eight per cent of dentists licensed in Pennsylvania came from out-of-state schools. Although the number of dentists licensed annually is equivalent to 79.6 per cent of Pennsylvania dental school graduates, when we deduct the inmigration we see that about 71.64 of Pennsylvania dental school graduates are staying in the Commonwealth. The net loss to outmigration is, thus, about 20 per cent.

A New York State study shows that of dentists who graduated from New York dental schools in 1950, 1955 and 1960-65, 84.5 per cent of New York residents who attended New York dental schools took up dental practice in New York. Second, this study showed that New York residents who attended out-of-state dental schools returned to practice in New York at a rate of 71.4 per cent. New York, thus, stood to gain 13.1 per cent more practicing dentists by admitting New York State students rather than out-of-state students.

If we examine Table 1, we see that our dental schools increased their total enrollment from 1,365 in 1962 to 1,613 in 1973, an average increase of 1.83 per cent annually.

When we compare the number of applicants with the first-year enrollment, we note that while the applicants almost doubled, the number enrolled in the first year increased by only 26 per cent or about 2.36 per cent annually.

In 1972, the dental schools graduated 35 more students than in 1962, a 10 per cent rate of increase, but the average number of graduates for the period, 332, was below the number of 1962 (353).

The per cent of applicants enrolled actually dropped from 22 per cent in 1962 to 13 per cent in 1972.

## Production of Licensed Dentists

Licensed dentists increased from 255 in 1965 to 385 in 1972 and averaged 79.64 per cent of graduates from Pennsylvania dental schools. Dental school deans' projections of graduates averaged 421 per year, 1973-1980, while the past trend would indicate a possibility of 570 graduates per year. Since the deans know the constraints of their schools, we have used their projections rather than the statistical trend.

TABLE 1

ENROLLMENT, APPLICANTS, FIRST-YEAR ENROLLMENT, GRADUATES, APPLICATION/ADMISSION RATIO AND CLASS ATTRITION, PENNSYLVANIA DENTAL SCHOOLS, 1962-1971

| Year | Total Enrollment[1] | Total Applicants[2] | First Year Enrollment[3] | Total Graduates[4] | Ratio Col. 2/ Col. 3 | FYE as Per Cent of Applicants | Per Cent Dental School Attrition Year 1 to 4 |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1962 | 1,365 | 1,535 | 342 | 353 | 4.60 | 22.3 | |
| 1963 | 1,358 | 1,742 | 363 | 322 | 4.57 | 20.8 | |
| 1964 | 1,336 | 2,069 | 370 | 335 | 5.59 | 17.0 | |
| 1965 | 1,349 | 2,415 | 370 | 309 | 6.52 | 15.0 | 9.64 |
| 1966 | 1,396 | 2,529 | 383 | 315 | 6.60 | 15.0 | 13.22 |
| 1967 | 1,445 | 2,584 | 401 | 310 | 6.44 | 15.0 | 16.21 |
| 1968 | 1,484 | 2,671 | 401 | 331 | 6.66 | 15.0 | 10.54 |
| 1969 | 1,587 | 2,843 | 403 | 305 | 7.05 | 14.2 | 20.36 |
| 1970 | 1,569 | 2,887 | 410 | 372 | 7.76 | 14.0 | 7.23 |
| 1971 | 1,582 | 3,038 | 411 | 398 | 7.39 | 13.0 | 7.73 |
| 1972 | 1,613 | | 431 | 388 | | | |
| Mean | 1,447 | 2,431 | 385 | 332 | 6.31 | 15.8 | 13.77 |

[1] Annual Report, 1971-72, Dental Education, American Dental Association, Chicago, Illinois, 1972, p. 21.

[2] Applicants to Dental School 1967, Table 5, 1963-67; Analyses of Applicants to Dental School and First Year Enrollment 1969, Table 2; Ibid., Table 3; Op. cit., Annual, p. 17.

[3] From American Dental Association reports.

[4] Op. cit., Annual Report, 1962-70; Survey of Deans of Pennsylvania Dental Schools.

While this report has many explanatory tables, we wish to present two more.

Table 2 shows the projected number of licensed dentists at the trend rate of 79.64 per cent applied to the deans' projections of graduates (Column 6).

Column 4 shows the number of dentists possible, omitting the eight per cent out-of-state licensees.

Column 5 indicates the obtainable number of licensed dentists by increasing resident graduates, according to the New York report, by 13.1 per cent, omitting eight per cent immigration.

Column 7 shows the obtainable number of licensed dentists, using a 92 per cent rate, which includes eight per cent immigration.

Table 3 shows resident and nonresident graduates based on the average rates for 1971 and 1972 (57.4 per cent). Column 5 indicates projected number of licensed dentists based on the deans' projections of graduates, 2,682 dentists. This number includes 747 nonresident graduates (2,682 - 1,935 = 747) and 214 graduates of out-of-state schools.

Dental Manpower Needs

As pointed out previously, Pennsylvania can meet the national average for dental manpower by licensing 2,900 dentists, 1970-1980, an annual demand for 290 dentists. The potential supply including nonresidents and immigration is projected as 268 annually. The average unmet need is estimated at 22 licensed dentists annually.

For optimum dental service to the population, however, each person should have adequate dental care every year. It is estimated that this would require 2,495 additional dentists, 1970-1980, for a total of 5,395 additional licensed dentists. This would represent an annual demand for 540 additional dentists. With a supply of 268 annually, the unmet need would be 272 annually.

To achieve 10 per cent of optimum dental service would require 315 additional dentists annually. With a supply of 268, the unmet need would be 47 dentists annually.

Pennsylvania dental schools can meet the challenge for more dental manpower by (1) enrolling more Pennsylvanians, especially from low dental care areas, thus reducing nonresident admissions and (2) by all dental schools changing to a three- instead of a four-year curriculum, increasing productivity by 25 per cent within a few years.

Both dental manpower demand and supply could be altered also by increased fluoridation of the water supply and increased use of dental auxiliaries.

TABLE 2

DENTAL MANPOWER SUPPLY, 1973-1980, BASED ON PROJECTIONS OF GRADUATES BY DENTAL SCHOOL DEANS

| Year | Deans' Projections Graduates[1] | Graduates Prior 8 Yrs. 1965-1972[2] | Col. 1/ Col. 2 | Resident Licensed Dentists Rate of .7164[3] | Resident Licensed Dentists Rate of .8474[4] | Dentists Licensed Entry Rate .7964[5] | Dentists Licensed Entry Rate .92 |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1973 | 392 | 320 | 72 | 281 | 332 | 312 | 361 |
| 1974 | 413 | 298 | 115 | 296 | 350 | 328 | 380 |
| 1975 | 404 | 314 | 90 | 289 | 342 | 322 | 372 |
| 1976 | 427 | 337 | 90 | 306 | 362 | 340 | 393 |
| 1977 | 433 | 325 | 108 | 310 | 367 | 345 | 398 |
| 1978 | 433 | 361 | 72 | 310 | 367 | 345 | 398 |
| 1979 | 433 | 372 | 61 | 310 | 367 | 345 | 398 |
| 1980 | 433 | 383 | 50 | 310 | 367 | 345 | 398 |
| Total | 3,368 | 2,710 | 658 | 2,412 | 2,854 | 2,682 | 3,098 |
| Mean | 412 | 339 | 82 | 302 | 357 | 335 | 387 |

[1]A Study of Dental Manpower Demand and Supply in Pennsylvania, Pennsylvania Department of Education, Harrisburg, Pennsylvania, 1974, Table 20, p. 34.

[2]These figures include eight per cent from out-of-state schools.

[3]This is the dental licensure entry rate--the eight per cent of out-of-state graduates.

[4]This entry rate assumes the past rate of .7164 + .131 increase developed by admitting a larger proportion of Commonwealth applicants.

[5]This licensure entry rate includes eight per cent of graduates from out-of-state schools.

[6]This licensure entry rate assumes 84.74 per cent from Pennsylvania and eight per cent from out-of-state schools.

TABLE 3

PROJECTIONS OF FIRST-YEAR ENROLLMENT, GRADUATES, RESIDENTS AND NONRESIDENTS AND DENTISTS LICENSEES, 1973-1980

| Year | Projections FYE[1] | Deans' Projections Graduates | Resident Graduates[2] | Nonresident Graduates[3] | Dentist Licensees Pa. Schools[4] | Dentist Licensees Out-of-State Schools[5] |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| 1973 | 421 | 392 | 225 | 167 | 312 | 25 |
| 1974 | 444 | 413 | 237 | 176 | 328 | 26 |
| 1975 | 427 | 404 | 232 | 172 | 322 | 26 |
| 1976 | 459 | 427 | 245 | 182 | 340 | 27 |
| 1977 | 465 | 433 | 249 | 184 | 345 | 28 |
| 1978 | 465 | 433 | 249 | 184 | 345 | 28 |
| 1979 | 465 | 433 | 249 | 184 | 345 | 28 |
| 1980 | 465 | 433 | 249 | 184 | 345 | 28 |
| Total | 3,611 | 3,368 | 1,935 | 1,433 | 2,682 | 216 |

[1]Assume application of average attrition rate of 1971 and 1972, 7.48 per cent, then FYE will be that percentage greater than the number of graduates.

[2]Using average of 1971 and 1972, 57.4 per cent and assuming that all may enter practice in Pennsylvania. A Study of Dental Manpower Demand and Supply in Pennsylvania, Pennsylvania Department of Education, Harrisburg, Pennsylvania, 1974, Table 19, p. 32.

[3]This assumes nonresident graduates as the average of 1971 and 1972, 42.6 per cent.

[4]Based on trend of licensing experience, 1966-1972, equal to 79.64 per cent of graduates.

[5]Graduates from out-of-state schools are assumed still to be eight per cent of licensees, as reported in 1966.

# OVERVIEW OF COMM-BACC SURVEY EFFORTS IN PENNSYLVANIA

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All four-year baccalaureate degree graduates in Pennsylvania are being surveyed this year to determine their first employment characteristics. The popular title for this study, "Comm-Bacc," was derived by William Toombs from the words Commonwealth Baccalaureate for his original 1971-72 study (1). One of the main purposes of the two statewide studies is to determine the correspondence between the major fields of preparation and the job structure. Specifically, such information about the degree to which students were able to obtain jobs in fields for which they had prepared should prove very helpful for them, career counselors and educational planners.

Highlights from Dr. Toombs' study reveal that one out of five graduates was still seeking employment in late summer or early fall; that 72 per cent of graduates with nonprofessional preparation found employment in occupations identified as remote to their college major; 72 per cent of the graduates remained in the state for employment; most women graduates stayed in the labor force or continued their education; and that Pennsylvania graduate school attendance is lower than the national level.

The present 18-item survey form was basically the work of John Basehore, State College Budget and Fiscal Specialist, Bureau of Planning, who initiated the present study in cooperation with the Division of Research. As press of other planning activities took more of his time, the Division of Research undertook to continue the study.

Mr. Basehore thoroughly analyzed follow-up forms currently in use by baccalaureate degree-granting institutions throughout Pennsylvania to determine typical information sought. He met with career counseling directors to obtain their reaction to tentatively selected items. Based on commonly used items, career directors' recommendations and needs of study, the following 18 items were selected for use: (1) name, (2) address, (3) phone, (4) sex, (5) social security, (6) race or ethnic group, (7) major field, (7a) education majors indicate certification area, (8) date of graduation, (9) attending graduate school?, (10) continue placement services?, (11) currently employed?, (12) employer's address, (13) work related to field of study?, (14) if not full time, seeking work?, (15) date of employment, (16) annual salary, (17) job title and (18) description of duties.

How coding problems involving several significant survey variables were met is illustrated in the following three examples. The "degree field" section of the Comm-Bacc card is used to code the degree field as identified by each of the respondents in items 7 and 7a. These codes include in excess of 250 individual subject fields that are grouped under 23 major academic subdivisions. They are commonly referred to as the HEGIS codes, as published in the booklet by Huff and Chandler, A Taxonomy of Instructional Programs in Higher Education, published by the U.S. Office of Education in 1970.

The determination of the four-digit occupational code is based upon the U.S. Department of Commerce 1970 Decennial Census Occupational Listing. The teacher category was expanded to include the individual classifications for special

education and adult and secondary education. Presently, there are 490 individual occupational classifications considered with major groups and divisions identified by aggregating the approximately 500 individual classifications.

The matching of classification is done by interpretation of the job title given and, in some cases, the description of duties or job function.

In respect to the derivation of an industry code for the survey responses, a listing of industries classifications was generated based upon the firm name and, in some cases, job title definition on standard industrial classification (SIC) number as assigned. Presently, the Directory of Manufacturing Firms in Pennsylvania, Pennsylvania Department of Commerce and the Pennsylvania Bureau of Employment Security industry listings are used in the coding determination. Presently, the approximate 9999 four-digit individual industry classification is being used based upon the 99 major group two-digit classification. For our purposes, approximately 72 two-digit classifications are being used for data analysis.

Many conferences were held within the Division of Research and between the division and other elements of the Pennsylvania Department of Education to generate tables for the final report which will accurately, usefully and thoroughly represent the survey findings.

Two sets of tables were established, one set considered essential to the Comm-Bacc study (see below) and another set considered important for those with special interests such as career counselors.

Prospective Comm-Bacc Tables

- Number of Follow-up Returns Received from the Baccalaureate Degree Graduates by Institution
- Number of Follow-up Returns Received from the Baccalaureate Degree Graduates by Major Discipline
- Employment Status and Sex of Baccalaureate Degree Graduates by Institutional Category
- Employment Status of Baccalaureate Degree Graduates by Institutional Category and Major Discipline
- Employment Status and Sex of Baccalaureate Degree Graduates by Higher Education Planning Region.
- Employment Status of Baccalaureate Degree Graduates by Higher Education Planning Region and Major Discipline
- Geographic Location and Sex of Graduates by Institutional Category
- Geographic Location and Sex of Employed Graduates by Major Discipline
- Occupation of the Baccalaureate Degree Graduates by Major Discipline
- Occupation of Female Baccalaureate Degree Graduates by Major Discipline

- Median Salary of Employed Graduates by Major Discipline
- Labor Force Participation Rates of Graduates by Major Discipline (Per Cent)
- Labor Force Participation Rates of Male Graduates by Major Discipline (Per Cent)
- Labor Force Participation Rates of Female Graduates by Major Discipline (Per Cent)
- Labor Force Participation Rates of Black Graduates by Major Discipline (Per Cent)
- Labor Force Participation Rates of American Indian Graduates by Major Discipline (Per Cent)
- Labor Force Participation Rates of Spanish Surname Graduates by Major Discipline (Per Cent)
- Labor Force Participation Rates of Oriental Graduates by Major Discipline (Per Cent)
- Labor Force Participation Rates of White and Other Graduates by Major Discipline (Per Cent)

REFERENCE

1. Toombs, William. The Comm-Bacc Study: Postbaccalaureate Activities of Degree Recipients from Pennsylvania Institutions 1971-1972, Center for the Study of Higher Education, The Pennsylvania State University, August 1973.

# SOME COMMENTS ON ENGINEERING MANPOWER OVER THE NEXT DECADE WITH REFERENCE TO HIGHER EDUCATION NEEDS

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My study of Pennsylvania's need for engineers is still in progress. It was hoped that it would be close to completion by now but there has been a great deal of difficulty in obtaining adequate data. This has been especially true with regard to the supply of graduate engineers in terms of current freshman enrollment. Estimates of engineer immigration as a source of supply also pose a difficult problem.

There are also serious problems in estimating demand for graduate engineers due to the very nature of the data base upon which such projections and assessments are currently made. For example, data from the U.S. Bureau of the Census are commonly used but, aside from the problem of sampling error for so small a subset of the population, those recorded by the census as engineers are really all those who say they are "engineers." No attempt is made to make sure that they are, in actual fact, operating as engineers in the professional sense of the term. Furthermore, those with engineering degrees who do not call themselves engineers, in other words managers, vice-presidents, etc., are excluded from the census count of engineers. Instead, they are included in some other count along with many other respondents with very different training and background. To this extent, census-based data and projections are systematically underestimating the number of professional engineers, while, as indicated, they grossly exaggerate the total reported.

The exaggeration arises because the census counts as an engineer any respondent who is called an engineer or who at least calls himself an engineer. As a consequence, we find the census listing 14-year old engineers, engineers with six years of schooling or less, engineers who work full time for 52 weeks out of a year and earn less than $3,000 per year and other exotics. Obviously, such data cannot be taken at face value. It must be corrected for the inflationary effect of including such respondents as air-conditioning installers, railroad engineers and street cleaners who call themselves sanitation engineers. How to do this poses a problem!

The only other reasonably definitive source of data on engineers has been that from the National Register of Engineers, particularly that of 1969. This National Register data tends to be a reasonably accurate assessment of the number of engineers in any given region who are members of one or more recognized professional engineering societies. It should be noted that the figures obtained from this source are very similar to those for engineers in the given area who are listed as registered engineers by the State Licensing Board four years later. Professional engineers apparently become licensed within four years following their graduation. The National Register figures are roughly one-half as large as the number of degree-holding engineers in Pennsylvania as estimated in 1970 census. This is really not an unexpected finding when one assumes that the difference between the two may be partly accounted for in terms of engineering graduates who are not yet certified as registered engineers. In addition, a number of engineers may not have joined any professional organization and hence National Register estimates, based on membership lists alone, are, to some degree, spuriously low.

The problems in this study are really quite similar to those encountered in any manpower projection or analysis effort. Admittedly, they are complicated here

by the fact that what an engineer really is in terms of job specification has not been arrived at in a consensual sense. The Engineers Joint Council defines an engineer as one who holds an engineering degree or who is registered by the state as a professional engineer, even if he considers himself as a nonengineer or as one who is a member of a recognized engineering society that requires demonstrated competence in lieu of a formal engineering degree and calls himself an engineer.

Obviously, this is a far cry from industry's definition of an engineer as one whom we hire for a position that uses "engineer" in its job title regardless of the actual educational and experience requirements expected of the job holder, nor does it resemble the U.S. census definition of an engineer as one who "says" he is an engineer.

It is worth noting at this point, that, as in the case of physicians and dentists, all of the elements required for the basic manpower supply and demand model we have used could have been provided through the licensing function of the state. Unfortunately, at present, Pennsylvania's licensing boards do not have the funds or the personnel to maintain the permanent data files required. Little is now actually recorded in a readily accessible form.

Although these problems do exist and although no agreed upon or direct projection of Pennsylvania's graduate engineering demand now exists, there are some things that I believe can be said at this point about the demand and supply picture over the coming years of this decade.

First, there can be no doubt that engineering as a profession is extremely sensitive to changes in the economic climate and to changes in federal and public spending for research and development in general. As a consequence, the demand for engineers tends to be out of synchronization with the supply much of the time. This is, of course, partly due to sudden changes in demand, but also it is due to the fact that student enrollments in engineering, as any other preprofessional or professional curriculum, are strongly influenced by the student's perception of whether his chosen profession is in demand now or is likely to continue to be in demand.

Students are also affected by the fact that initial employment income fluctuates as a function of current demand. Students, therefore, according to Freeman (1), gravitate toward those professions having a higher financial reward. As a consequence, student entry is partly a function of the existing salary structure at the time of entry.

In short, students are more inclined to enter the educational pipeline as students of engineering during periods of high need and salary and less inclined to do so during periods of low demand and unemployment among engineering graduates. As a consequence, we frequently find students graduating in large numbers during periods of low need and high unemployment and too few students graduating during periods of high demand need. This is simply because the economic and societal priorities change so rapidly in today's world.

We are in such a situation right now! During the last several years there has been a great deal of publicity about unemployment among engineers, about low demand and about the difficulty of finding employment among experienced engineers, particularly aerospace engineers.

The young people who would normally have chosen engineering as a major have, therefore, turned to other options. This is ironic, to say the least, since the

unemployment ratio for engineers as a whole was lower than for any other category of college graduates and the low demand and unemployment was largely concentrated among older engineers involved in government research and development efforts which were discontinued, including, of course, the NASA space program.

As a result, there are now, in the pipeline and graduating, fewer future engineers than existing or projected future needs would require during the next four or five years.

The demand for engineering graduates has, in fact, risen sharply since last year (up 31 per cent according to the College Placement Council). One firm was seeking 100 Ph.D.s in engineering alone while only a year or so ago they were not even attempting to recruit engineers for their firm.

Several different authors or groups have made attempts to project national engineering demand and supply to 1980 or beyond. All of them seem to agree that the present supply will not be equal to demand due to the reduced student rate of entry over the past several years. They do not, however, agree on the longer term prospects because their methods differ widely as to the assumptions made.

Furthermore, it may be said that a dilemma clearly exists for any would-be forecaster of engineering demand. Not only is the existing data base questionable but also recent events such as the energy crisis have changed the demand picture in as yet unpredictable ways. It is certain, however, that engineers are going to be, and even now are, in demand for energy research and development. The emphasis on coal could very well reverse the declining trend in mining for Pennsylvania. Whether this means that a great many more mining engineers will be needed is, however, not completely certain.

It is possible that the technology that will have to be developed will emphasize machinery and extraction techniques that will result in a demand for more mechanical engineers rather than for mining engineers as such. Nevertheless, mining engineers are even now reported as being in short supply.

This much, then, seems evident--engineers are easily impacted by economic cycles since they now work largely in basic industries that are most affected by an economic downturn. Our engineers might do well to explore the possibility of a more diversified application of engineering to those service segments of our economy that do not use engineering extensively. Medicine and education are two that come to mind.

We can see this diversification already occurring to some degree in that, even in 1972, such fields as airport engineering, hospital cost control, the application of fluidics or microelectronics, etc. are rapidly developing and often in industries that previously had little need for engineers.

There is almost universal agreement that engineer shortages will worsen and become chronic in the years ahead. One recent Department of Labor projection indicates a severe pinch around 1980 when an assumed lack of interest in engineering among students will be compounded by a decline in the college age population coinciding with the retirement of many engineers who began their careers in the early 1950s and late 1940s.

A hopeful sign, however, lies in the fact that engineering enrollments have stopped dropping and are now on the rise. Nevertheless, the freshman of 1974 will

be the graduate of 1978 and 1974 enrollments are not yet back to predecline levels, let alone at a level likely to meet the increased demand of 1980.

The dilemma now for the schools of engineering is not one of whether or not to expand. It is rather one of how to recruit enough students to meet the probable demand, how to so educate them that they can fill the positions likely to open up. New technology, new areas of application are rapidly emerging. The training of an engineer dare not be too highly specialized or he will be unable to adjust to the new situations that will emerge.

A greater emphasis on continued education, possibly by the Open University approach, may be required to assist our graduates in avoiding the problem of being unemployed because their knowledge and skills have become obsolescent in the face of new knowledge.

Constant awareness of the changing face of our society and of its needs will have to be cultivated in order to keep our engineering education congruent with the needs expressed by employers. Active research, as to areas of application not now commonplace in the service segment, will be necessary if engineering is to broaden its employment base and be less susceptible to economic changes in federal research and development priorities.

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1. Freeman, Richard B. The Market for College Trained Manpower: A Study in the Economics of Career Choice. Harvard University Press, Cambridge, Massachusetts, 1971.

# TEACHER MANPOWER SUPPLY AND DEMAND IN PENNSYLVANIA

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If society were prepared to supply unlimited resources for education, there would doubtless be an almost unlimited demand for teachers. Since society has many competing demands for resources, it is quite clear that it will supply money for education only in the amount for which valid returns cannot only be claimed but substantiated with evidence.

Some may say, "What does it matter that Pennsylvania prepares more than 20,000 teachers a year but hires only about 8,000 of them. These 12,000 excess teachers have a good education that can be used in many occupations."

There is some truth in this statement, but high school guidance counselors and higher education officials have a duty not only to help students get an education but, insofar as possible, to get an education for a specific job. Parents want their sons and daughters prepared to be self-supporting in a suitable occupation that will pay dividends on their investment in higher education. If Susan is going to find work as a social worker, it is much more satisfactory for everybody for her to study to be a social worker.

While it is impossible in a free society to establish annually manpower quotas for all occupations, it is possible to make continuing studies of the supply and demand for professional workers and to disseminate the findings to enable everybody in the educational process to make better operational and planning decisions. Such information can also prevent students from making blind choices. If students know the amount of teacher oversupply and still say, "I am going to prepare to be a teacher," that is their option if they can qualify for certification.

We propose to discuss the methodology of teacher supply and demand studies and then to examine the situation in Pennsylvania.

## Teacher Supply

Theoretically, the annual supply of teachers emerges from our colleges and universities each spring. This assumption requires a number of stipulations:

- The reported number of teacher-prepared graduates includes a number of out-of-state students. While our Division of Statistics collects data on the number of education graduates who obtained jobs in another state, it does not have information on how many of these students came from another state and never intended to stay in Pennsylvania after graduation. Data on outmigration of teachers is probably not completely accurate.

- The reported annual teacher supply from Pennsylvania colleges and universities does not include the number of teachers who came from an institution outside the state. Presently no information exists on annual teacher inmigration.

- The teacher supply must include those who have left teaching for a year or so and annually return to the profession. In Pennsylvania, the number of returnees to the teaching profession averaged 11.8 per cent of total new demand for teachers, 1964-1972, or more than 3,000 teachers per year. In our study we have assumed the continuation of this trend. With teacher salaries rising significantly every year, along with inflation of the cost of living, the returnee rate may, however, actually increase.

- The rate of entry of college graduates into teaching in Pennsylvania has varied from 56.7 per cent in 1960-61 to 39.1 per cent in 1971-72. A National Education Survey of student intentions in colleges reported in June 1973 showed a declining intention to enter teaching, class of 1972 through 1974, ranging from 33.8 per cent to 21.87 per cent, indicating that the message of an oversupply of teachers is getting through to students. This national trend will doubtless show up in Pennsylvania.

Teacher Demand

Demand for teachers in public schools is a function of a number of factors, first and most important, the population birth rate. Beginning with 1958, Pennsylvania birth rate has declined every year except 1970.

A second factor in teacher demand is class size. Counting all classroom teachers and all pupils, the Division of Statistics reported a decline in average class size from 26.2 pupils per teacher in 1963-64 to 21.1 per teacher in 1972-73. In these ratios, the small classes in special education and secondary education tend to conceal the much larger classes in elementary education. If the trend of declining pupil-teacher ratios continues, it could reach 18 pupils per teacher in 1982-83. In our study we assumed that the 21.7:1 ratio of 1971-72 is more likely to prevail because of the dramatic annual increases in the cost of education.

A third factor in teacher demand is replacement rate. This includes loss of teachers by withdrawal for homemaking, administrative and supervisory positions in education, business and industry and the like. It includes mortality, disability, retirement and outmigration. Table 1 of our study shows total replacement of teachers, nationally, 1959-1970, at an average rate of 7.5 per cent, 1970-1981. Statistics on withdrawal from teaching, provided by the Pennsylvania Public School Retirement System, age 22 to 70, show a total average annual rate of 7.65 per cent for men and 8.62 per cent for women. Our study has used a replacement rate of eight per cent.

A fourth factor in teacher demand may be an increase in educational services such as guidance services and special education services.

A fifth factor in teacher demand could be large increases in state and federal financial support of public schools. But rapidly increasing per pupil costs seem likely to use any additional funds without significantly increasing services.

Analysis of Teacher Demand and Supply in Pennsylvania

The Division of Statistics annually reports on the number of teacher-prepared graduates and what happens to them.

TABLE 1

PENNSYLVANIA TEACHERS PREPARED, TEACHING AND NOT TEACHING AND PERCENTAGES

| Year | Teaching Total Prepared[1] | Total Teaching[2] | Per Cent | In-State[2] | Per Cent | Out-of-State[2] | Per Cent | Not Teaching[2] | Per Cent | Out-of-State + Not Teaching in Pa. |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| 1960-61 | 8,405 | 6,595 | 78.5 | 4,768 | 56.7 | 1,827 | 21.7 | 1,810 | 21.5 | 3,637 |
| 1961-62 | 9,434 | 7,316 | 77.5 | 5,229 | 55.4 | 2,087 | 22.1 | 2,118 | 22.5 | 4,205 |
| 1962-63 | 10,256 | 8,032 | 78.3 | 5,868 | 57.2 | 2,164 | 21.1 | 2,224 | 21.7 | 4,388 |
| 1963-64 | 11,625 | 8,942 | 76.9 | 6,320 | 54.4 | 2,622 | 22.6 | 2,683 | 23.1 | 5,305 |
| 1964-65 | 11,912 | 9,245 | 77.6 | 6,580 | 55.2 | 2,665 | 22.4 | 2,667 | 22.4 | 5,332 |
| 1965-66 | 12,354 | 9,328 | 75.5 | 6,924 | 56.1 | 2,404 | 19.5 | 3,026 | 24.5 | 5,430 |
| 1966-67 | 12,954 | 9,771 | 75.4 | 7,455 | 57.6 | 2,316 | 17.9 | 3,183 | 24.6 | 5,499 |
| 1967-68 | 15,191 | 11,475 | 75.5 | 8,832 | 58.1 | 2,643 | 17.4 | 3,716 | 24.5 | 6,359 |
| 1968-69 | 17,228 | 12,488 | 72.5 | 9,686 | 56.2 | 2,802 | 16.3 | 4,740 | 27.5 | 7,542 |
| 1969-70 | 18,182 | 11,686 | 64.3 | 8,980 | 49.4 | 2,706 | 14.9 | 6,496 | 35.7 | 9,202 |
| 1970-71 | 19,172 | 10,366 | 53.6 | 8,124 | 42.3 | 2,262 | 11.8 | 8,786 | 46.4 | 11,048 |
| 1971-72 | 20,295 | 9,959 | 49.1 | 7,932 | 39.1 | 2,027 | 9.9 | 10,336 | 50.9 | 12,363 |

[1]The Preparation and Occupational Pursuits of Elementary, Secondary and Ungraded Teachers 1971-72, Our Colleges and Universities Today, Division of Educational Statistics, Pennsylvania Department of Education, Harrisburg, 1973, p. 4ff.

[2]Ibid., p. 14ff.

Teacher supply from Pennsylvania colleges increased from 8,405 in 1960-61 to 20,295 in 1971-72 or 241 per cent, while pupil enrollment dropped from 2,529,954 to 2,361,285 or 168,669, about 6.6 per cent. The number of teachers supplied by the colleges has exceeded the actual demand for teachers, as shown in a comparison of columns 1 and 2 of Table 1. The number hired in Pennsylvania has dropped from 56.7 per cent in 1960-61 to 39.1 per cent in 1971-72. Although the number of teacher graduates going out of state has remained at about 2,000 annually, it now represents about 10 per cent of the supply as compared to 22 per cent in 1960-61.

At the same time, the number failing to get a teaching job (column 8) has increased from 1,810 to 10,336 and now represents more than 50 per cent. If we went no farther, it would be clear that Pennsylvania has an oversupply of teachers.

If we examine Table 2, we note that the number of live births reached a peak of 254,997. Since 1958, with the exception of 1970, the number of births has dropped every year. The decline in births has a cumulative effect on pupil enrollment. The drop of 17,829 births in 1972 (should births continue at the rate of 163,110 per year) will, over 12 grades, result in a decline of more than 200,000 in total public school enrollment.

We should note that while Pennsylvania had 73,617 classroom teachers in 1960, the number increased to 111,682 by 1972, an increase of 37,965, but as previously pointed out, the number of pupils decreased by 168,699 and the net decrease in births was 82,505. With each annual cohort of pupils being smaller, enrollment continues to decline. The 1972 cohort of 163,110 births is 77,789 smaller than the 1960 cohort.

At the ratio of 21.7 pupils per teacher, this drop in births represents a drop in demand for teachers of 367 per year and you can see that the number of births is projected to continue to decline.

## Teacher Demand Analysis

You will note in column 4 of Table 3 that the number of teachers hired increased each year through 1976, but this was supported by increased enrollment only through 1971. Enrollment changes for 1972-1980 will produce a declining need for teachers, as shown in column 5.

In column 6, we found no additional teachers needed from 1973-1980 to reduce class size. It is our assumption that the cost of teachers' salaries is becoming so great that the state will be unable to maintain an average class size below 21.7.

Replacement need for teachers is shown in column 7. It is estimated at eight per cent of the staff of the previous year. This rate is greater than the 7.6 per cent national rate and a little less than the rate suggested by data from the teacher retirement system.

Total demand is shown in column 8. It represents the sum of columns 5, 6 and 7.

## Teacher Supply and Need

In column 3 of Table 4, we see the number of college graduates hired, 1964-1972, and in column 1, the total number of teachers hired. Column 1 minus column 3

TABLE 2

RESIDENT LIVE BIRTHS IN PENNSYLVANIA, 1916-1972,
AND PROJECTIONS, 1973-77

| Year | Live Births | Annual Change | Year | Live Births | Annual Change |
|---|---|---|---|---|---|
| 1916 | 217,449 | | 1948 | 227,227 | -21,286 |
| 1917 | 222,505 | 4,056 | 1949 | 224,581 | -2,646 |
| 1918 | 220,170 | -2,335 | 1950 | 221,635 | -2,946 |
| 1919 | 207,685 | -12,485 | 1951 | 235,074 | 13,439 |
| 1920 | 220,462 | 12,777 | 1952 | 239,964 | 4,890 |
| 1921 | 229,452 | 8,990 | 1953 | 239,206 | -758 |
| 1922 | 214,348 | -15,104 | 1954 | 245,521 | 6,315 |
| 1923 | 217,235 | 2,887 | 1955 | 242,591 | -2,930 |
| 1924 | 223,103 | 5,868 | 1956 | 248,019 | 5,428 |
| 1925 | 215,120 | -7,983 | 1957 | 254,997 | 6,978 |
| 1926 | 207,696 | -7,424 | 1958 | 249,810 | -5,187 |
| 1927 | 210,001 | 2,305 | 1959 | 246,615[1] | -3,195 |
| 1928 | 200,769 | -9,232 | 1960 | 241,099[1] | -5,516 |
| 1929 | 189,524 | -11,245 | 1961 | 240,172[2] | -1,927 |
| 1930 | 189,458 | 66 | 1962 | 226,393[2] | -13,779 |
| 1931 | 178,714 | -10,744 | 1963 | 221,537[3] | -4,856 |
| 1932 | 168,534 | -10,180 | 1964 | 218,515 | -1,022 |
| 1933 | 157,046 | -13,488 | 1965 | 204,105 | -14,410 |
| 1934 | 160,238 | 3,192 | 1966 | 195,869 | -8,236 |
| 1935 | 161,166 | 928 | 1967 | 188,706 | -7,163 |
| 1936 | 159,393 | -1,773 | 1968 | 185,729 | -2,977 |
| 1937 | 161,133 | 1,740 | 1969 | 185,046 | -683 |
| 1938 | 165,708 | 4,675 | 1970 | 192,154 | 7,108 |
| 1939 | 160,774 | -4,934 | 1971 | 180,939 | -11,215 |
| 1940 | 165,456 | 4,682 | 1972 | 163,110 | -17,829 |
| 1941 | 174,193 | 8,737 | Projection | | |
| 1942 | 197,177 | 22,984 | 1973 | 154,200 | -8,910 |
| 1943 | 199,366 | 2,189 | 1974 | 153,300 | -900 |
| 1944 | 178,370 | -20,996 | 1975 | 152,500 | -800 |
| 1945 | 173,799 | -4,581 | 1976 | 152,000 | -500 |
| 1946 | 218,376 | 44,577 | 1977 | 151,500 | -500 |
| 1947 | 248,513 | 30,137 | | | |

[1] The Enrollment Picture to 1980, Research Studies and Reports Series No. 10, Department of Public Instruction, 1962, p. 1: Data Source for 1916-60.

[2] Projections to 1979-80, Bureau of Educational Statistics, Pennsylvania Department of Education, 1970, p. 2.

[3] Projections to 1982-83, Division of Educational Statistics, Pennsylvania Department of Education, 1973, p. 2: Data Source for 1963-77.

TABLE 3

ESTIMATED CLASSROOM-TEACHER DEMAND, PUBLIC ELEMENTARY AND SECONDARY SCHOOLS IN PENNSYLVANIA, 1964-1980

| Year | Enrollment, K-12 | | | Classroom Teachers Employed[3] | Demand for Additional Certificated Teachers | | | |
|---|---|---|---|---|---|---|---|---|
| | Elementary[1] | Secondary[1] | Total | | Enrollment Increase-Decrease | Pupil-Teacher Ratio Changes[4] | Teacher Replacement Turnover[5] | Total New Demand |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 1964 | 1,194,955 | 966,808 | 2,161,763 | 84,012 | 1,302 | 1,634 | 6,506 | 9,442 |
| 1965 | 1,214,231 | 970,358 | 2,184,589 | 85,800 | 849 | 673 | 6,720 | 8,243 |
| 1966 | 1,233,765 | 988,248 | 2,222,013 | 90,140 | 1,468 | 2,920 | 6,864 | 11,252 |
| 1967 | 1,258,581 | 1,019,787 | 2,278,368 | 95,500 | 2,282 | 3,330 | 7,211 | 12,586 |
| 1968 | 1,257,226 | 1,049,724 | 2,306,950 | 100,959 | 3,330 | 4,224 | 7,640 | 15,194 |
| 1969 | 1,267,059 | 1,078,943 | 2,346,002 | 106,104 | 1,705 | 3,840 | 8,077 | 13,622 |
| 1970 | 1,264,247 | 1,099,570 | 2,363,817 | 108,772 | 806 | 2,006 | 8,488 | 11,300 |
| 1971 | 1,248,839 | 1,121,826 | 2,370,665 | 109,035 | 318 | 0 | 8,202 | 8,520 |
| 1972 | 1,224,959 | 1,136,326 | 2,361,285 | 111,682 | -432 | 0 | 8,722 | 8,290 |
| Projections[2] | | | | | | | | |
| 1973 | 1,200,300 | 1,152,000 | 2,352,300 | 112,600 | -414 | 0 | 8,935 | 8,521 |
| 1974 | 1,177,700 | 1,150,500 | 2,327,900 | 113,200 | -1,124 | 0 | 9,008 | 7,884 |
| 1975 | 1,159,900 | 1,139,400 | 2,309,300 | 114,000 | -857 | 0 | 9,056 | 8,199 |
| 1976 | 1,134,400 | 1,123,500 | 2,257,900 | 114,500 | -2,369 | 0 | 9,120 | 6,751 |
| 1977 | 1,097,900 | 1,097,900 | 2,198,500 | 114,400 | -2,829 | 0 | 9,160 | 6,331 |
| 1978 | 1,067,800 | 1,064,400 | 2,131,200 | 114,300 | -3,101 | 0 | 9,150 | 6,049 |
| 1979 | 1,038,100 | 1,026,800 | 2,064,100 | 112,300 | -3,083 | 0 | 9,144 | 6,061 |
| 1980 | 1,010,800 | 994,400 | 2,004,800 | 110,700 | -1,741 | 0 | 8,984 | 6,251 |

[1]Public Elementary-Secondary School Report 1972-73, Division of Educational Statistics, Pennsylvania Department of Education, Harrisburg, Pennsylvania, 1973, Tables 1 and 1a.

[2]Projections, Selected Statistics for Pennsylvania to 1982-83, Division of Educational Statistics, Pennsylvania Department of Education, Harrisburg, Pennsylvania, 1974, pp. 7-8.

[3]Ibid., p. 21.

[4]Op. cit., Projections, p. 30. Changes in teacher-pupil ratios given here were used through 1971-72, at which time the ratio was 21.7 to 1. From 1973 to 1980, this ratio is also used.

[5]Replacements estimated as eight per cent of total staff of previous year, the national rate used in USOE publications. The 7.5 per cent rate in Table 2 is for public and nonpublic schools.

TABLE 4

ESTIMATED CLASSROOM-TEACHER DEMAND AND SUPPLY IN PENNSYLVANIA, 1964-1980

| Year | Demand[1] | Supply of Teachers: Experienced Returnees[2] | Supply of Teachers: College Graduates Needed[3] | Supply of Teachers: Teacher Supply from Colleges[4] | Pa. Excess Supply[5] | Out-of-State[6] | Net Pa. Surplus[7] |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1964 | 9,442 | 3,122 | 6,320 | 11,625 | 5,315 | 2,622 | 2,693 |
| 1965 | 8,243 | 1,663 | 6,580 | 11,912 | 5,332 | 2,665 | 2,667 |
| 1966 | 11,252 | 4,328 | 6,924 | 12,354 | 5,430 | 2,404 | 3,026 |
| 1967 | 12,586 | 5,131 | 7,455 | 12,954 | 5,499 | 2,316 | 3,183 |
| 1968 | 15,194 | 6,362 | 8,832 | 15,191 | 6,359 | 2,643 | 3,716 |
| 1969 | 13,622 | 3,936 | 9,686 | 17,228 | 7,542 | 2,802 | 4,740 |
| 1970 | 11,300 | 2,320 | 8,980 | 18,182 | 9,202 | 2,706 | 6,496 |
| 1971 | 8,520 | 890 | 8,124 | 19,172 | 11,048 | 2,262 | 8,786 |
| 1972 | 8,290 | 1,281 | 7,932 | 20,295 | 12,363 | 2,027 | 10,336 |
| Projections | | | | | | | |
| 1973 | 8,521 | 1,005 | 7,516 | 20,300 | 12,784 | 1,931 | 10,856 |
| 1974 | 7,884 | 930 | 6,954 | 20,500 | 13,546 | 1,839 | 11,707 |
| 1975 | 8,199 | 967 | 7,232 | 20,300 | 13,268 | 1,751 | 11,517 |
| 1976 | 6,751 | 797 | 5,954 | 20,500 | 14,546 | 1,688 | 12,858 |
| 1977 | 6,331 | 747 | 5,584 | 20,200 | 14,616 | 1,529 | 13,087 |
| 1978 | 6,049 | 714 | 5,335 | 19,800 | 14,465 | 1,456 | 13,009 |
| 1979 | 6,061 | 715 | 5,346 | 19,500 | 14,154 | 1,387 | 12,767 |
| 1980 | 6,251 | 738 | 5,513 | 19,200 | 13,687 | 1,321 | 12,366 |

[1]From Table 4, column 8, p. 7, fall report, September 1973.

[2]Experienced returnees for 1964-1972 equal column 1 minus column 3; for 1973-1980, estimated at average rate for 1971 and 1972; 11.8 per cent of total new demand, column 1.

[3]From Table 5, column 4 for 1964-1972; for 1973-1980, column 1 minus column 2.

[4]From Projections, Selected Statistics to 1981-82, Division of Educational Statistics, Pennsylvania Department of Education, Harrisburg, Pennsylvania, 1973, p. 18ff.

[5]Column 5 equals column 4 minus column 3.

[6]Preparation and Occupational Pursuits of Elementary, Secondary and Ungraded Teachers, 1971-72, Division of Educational Statistics, Pennsylvania Department of Education, Harrisburg, Pennsylvania, 1973, p. 16ff, provides data for 1964-1972. Projections for 1970-1980 are at a linear rate of -4.76 per cent.

[7]Column 7 equals column 5 minus column 6.

equals column 2--experienced returnees hired. This includes an unknown number of teachers from out of state. This trend is projected for 1973-1980.

College graduates needed, compared with those prepared to teach, produced the excess supply indicated in column 5. Reducing the excess supply by those teachers who go out of state, we show the net surplus of teachers in column 7.

Summary

If guidance counselors, education officials and students act on the basis of the teacher oversupply situation, they will invalidate our projections and that would be an efficient action for our whole state.

# DEMAND, SUPPLY AND EDUCATIONAL REQUIREMENTS IN ALLIED HEALTH AND HEALTH-RELATED OCCUPATIONS

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In recent years, there has been a rising demand for a broad range of health services. According to the latest Health Manpower Source Book, this demand has resulted in a tremendous proliferation of occupations, occupational titles, occupational nomenclature and education and training requirements.

Currently, there are more than four million workers in the health occupations. There are about 600 different jobs ranging from clerical positions, which require no education beyond high school, to skilled professions for which training extends for a number of years beyond the baccalaureate degree. By 1980, it is expected that six million persons will be employed in the health services. Most of these will be in occupations offering supportive services to physicians, surgeons, dentists and the like. It can be assumed that with the increasing demand for health services and the growing number of persons employed in this field, there will be some "new health" occupations emerging. For example, in recent years, we have experienced the emergence of an allied health occupation commonly known as the "physician's assistant." The American Medical Association approved title is "assistant to the primary care physician." The physician's assistant, according to the AMA, is to provide patient services under supervision of a licensed doctor of medicine. Some of the functions of primary care physicians involve medicine, surgery, pediatrics, psychiatry and obstetrics. The public generally consults directly with the physician who is often the one to whom a patient turns for counseling as well as his concerns about illness or injury. The work of the physician's assistant is tailored to relieve the physician of a number of functions and tasks. Briefly, some of these include:

- Receiving patients, obtaining case histories, performing certain physical examinations.
- Assisting in laboratory procedures.
- Caring for wounds and suturing.
- Responding to emergency situations during the physician's absence.

A minimum of two years of formal education has been established by medical colleges, universities, community colleges and hospitals before a physician's assistant is allowed to practice under a doctor's supervision.

In other allied health and health-related occupations, the education and training requirements vary considerably (refer to Figure 1).

The education and training of health personnel is, as we know, a serious and demanding responsibility. However, to meet the growing needs of health services, we must have reliable data concerning the demand and supply of health workers. It is known that overestimating or underestimating the demand and supply may result in improper development of human resources as well as a waste of money. Some fairly accurate information is available from our higher education institutions, which

Figure 1

Years of Education and Training Beyond High School
for Careers in Selected Occupations*

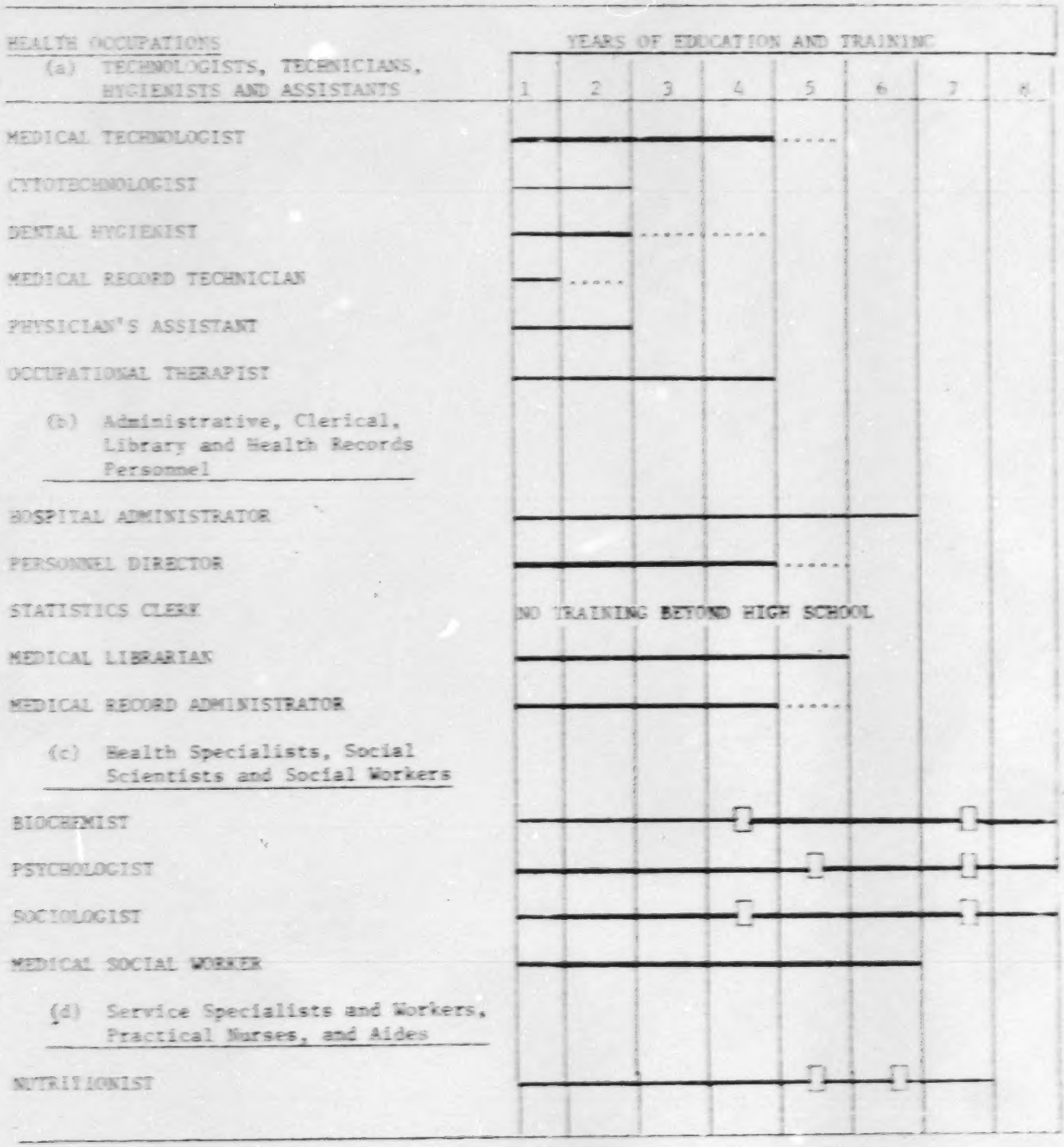
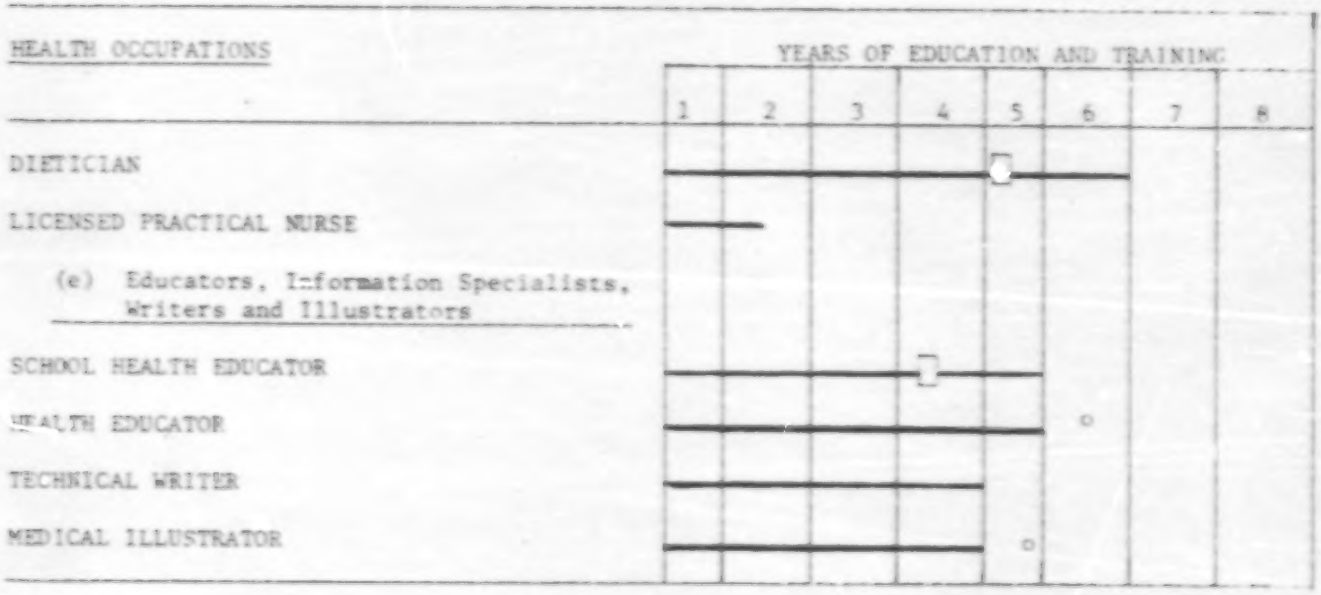


Figure 1
(Continued)




SYMBOLS

——— Training time required in college or university.

..... Requires apprenticeship, special course, or on-the-job training.

□ First square means one can get a junior professional job after college. Second square means more study is desirable.

o More professional years in college are desirable.

*Source: Health Careers Guidebook, U.S. Department of Health, Education, and Welfare, Washington, D.C., 1973.

shows the historical trends in number of graduates in select health and health-related fields. Our colleges and universities educate a significant number of health supportive personnel and there is evidence that the number of graduates in many health programs are increasing annually. On the other hand, certain occupations or professions such as pharmacy have reached a degree of stability; therefore, the college graduate output in this field can be expected to be relatively low (refer to Table 1).

Limited information is available about projected employment in select allied health and health-related occupations. The National Planning Association made some projections on select health occupations to 1990 (refer to Table 2).

Nurses are among the most significant contributors to health services. It has often been repeated that there is a shortage of nurses. However, in 1972, nationally, there were 778,000 active registered nurses and 427,000 active practical nurses. At the end of 1973, in Pennsylvania there were 140,000 active RNs and 50,000 active PNs. Although 1972 national statistics are compared to 1973 state statistics, Pennsylvania obviously has a lion's share of both RNs and PNs, about 17 and 11 per cent, respectively.

There are three types of programs from which we obtain our current supply of nurses--the baccalaureate degree, the associate degree and the diploma. In 1973, there were 113 nursing institutions offering these programs in Pennsylvania (refer to Table 3).

Between January 1974 and June 1976, 14 fully approved schools of nursing plan to close their programs (six in 1974, three in 1975 and five in 1976).

Practical (diploma granting) nursing institutions total 54 in Pennsylvania. During 1973, three hospitals and three vocational schools closed their fully approved practical nursing programs (refer to Table 4).

According to the Department of Health, Education, and Welfare, hospital-based diploma programs are beginning to close and the education and training of nurses is moving toward programs which are provided in an academic setting. Thus, many hospital-based programs are now closing due to an inadequate number of qualified faculty, rising costs and enrollment vacancies.

The implications for Pennsylvania might be that as programs are dropped by the hospitals and a few vocational-technical schools, colleges and universities may become increasingly involved in offering more programs in nursing (refer to Table 5).

In summarizing, allied health and health-related programs conducted at higher education institutions are generally proliferating. It now appears that because of the growing demand for health services by the public, there may be a need to develop new health programs and techniques to meet this demand. Finally, in Pennsylvania and the nation as a whole, there is a trend to discontinue hospital nursing programs due to qualified faculty shortages, rising hospital costs and student lack of interest in taking hospital-based nursing programs. Conversely, there has been an increase in the number of colleges and universities, in Pennsylvania, in supporting professional nursing programs.

TABLE 1

GRADUATES IN SELECT ALLIED HEALTH AND HEALTH-RELATED PROGRAMS, PENNSYLVANIA INSTITUTIONS OF HIGHER EDUCATION, 1969-1973*

| Program | 1969 | 1970 | 1971 | 1972 | 1973 |
|---|---|---|---|---|---|
| Medical Laboratory Technologies | 89 | 100 | 129 | 167 | 198 |
| Occupation Therapy/Occupation Therapy Assistants | 28 | 40 | 69 | 44 | 71 |
| Licensed Practical Nurse | 94 | 181 | 154 | 255 | 320 |
| Hospital Administration | -- | 4 | 8 | -- | 95 |
| Speech Pathology/Audiology/ Correction | 214 | 304 | 321 | 328 | 427 |

*Source: Pennsylvania Department of Education, Division of Educational Statistics, Harrisburg, 1969-1973.

TABLE 2

EMPLOYMENT IN SELECT ALLIED HEALTH AND HEALTH-RELATED OCCUPATIONS IN PENNSYLVANIA, 1970-1990 (INTERIM REPORT)*

| Occupation | Empl. 1970 | Est. Empl. 1975 | Proj. Empl. 1980 | Change 1970-1980 | Per Cent Change | Proj. Empl. 1985 | Proj. Empl. 1990 | Change 1970-1990 | Per Cent Change |
|---|---|---|---|---|---|---|---|---|---|
| Clinical Laboratory Technicians/Technologists | 7,159 | 8,221 | 9,212 | 2,053 | 29 | 10,016 | 11,065 | 3,906 | 55 |
| Dental Assistants | 3,703 | 4,228 | 4,732 | 1,029 | 28 | 5,189 | 5,683 | 1,980 | 53 |
| Dental Hygienists | 806 | 927 | 1,048 | 242 | 30 | 1,159 | 1,273 | 467 | 58 |
| Dental Laboratory Technicians/Technologists | 1,623 | 1,839 | 2,045 | 422 | 26 | 2,230 | 2,431 | 808 | 50 |
| Dietitians | 2,157 | 2,475 | 2,759 | 602 | 28 | 3,013 | 3,281 | 1,124 | 52 |
| Health Administrators | 4,130 | 4,745 | 5,332 | 1,202 | 29 | 5,863 | 6,427 | 2,297 | 56 |
| Health Aides | 5,807 | 6,589 | 7,342 | 1,535 | 26 | 8,023 | 8,750 | 2,943 | 51 |
| Health Records Technicians | 569 | 651 | 729 | 160 | 28 | 799 | 874 | 305 | 54 |
| Health Technicians | 3,589 | 4,101 | 4,580 | 991 | 28 | 5,014 | 5,470 | 1,881 | 52 |
| Nurses, Practical | 18,697 | 21,236 | 23,788 | 5,091 | 27 | 26,094 | 28,551 | 9,854 | 53 |
| Nurses, Registered | 60,147 | 66,136 | 72,086 | 10,939 | 18 | 77,720 | 83,861 | 23,714 | 39 |
| Optometrists | 1,203 | 1,345 | 1,494 | 291 | 24 | 1,627 | 1,773 | 570 | 47 |
| Pharmacists | 6,863 | 7,208 | 7,487 | 624 | 9 | 7,754 | 8,030 | 1,167 | 17 |
| Psychologists | 1,572 | 1,835 | 2,081 | 509 | 32 | 2,306 | 2,536 | 964 | 61 |
| Radiologic Technicians/Technologists | 3,239 | 3,686 | 4,128 | 889 | 27 | 4,525 | 4,952 | 1,713 | 53 |
| Secretaries, Medical | 6,039 | 6,881 | 7,677 | 1,638 | 27 | 8,396 | 9,169 | 3,130 | 52 |
| Therapists | 4,680 | 5,362 | 6,007 | 1,327 | 28 | 6,598 | 7,207 | 2,527 | 54 |
| Therapy Assistants | 110 | 124 | 137 | 27 | 25 | 147 | 159 | 49 | 45 |
| Veterinarians | 722 | 592 | 505 | -217 | -30 | 473 | 457 | -265 | -37 |

*Source: Projections of Employment Demand by Industry and Occupation for Labor Market Areas in Pennsylvania, (Project No. 14-2119) National Planning Association, The Research Center, Washington, D.C., January 29, 1974.

TABLE 3

PROFESSIONAL NURSING INSTITUTIONS IN PENNSYLVANIA 1973*
(COLLEGES, UNIVERSITIES AND HOSPITAL SCHOOLS OF NURSING)

| PN Institutions | Number |
|---|---|
| Colleges and Universities | |
| Baccalaureate Degree Programs | 20 |
| Fully Approved | (14) |
| Initially Approved | (5) |
| Provisionally Approved | (1) |
| Associate Degree Programs | 15 |
| Fully Approved | (9) |
| Initially Approved | (5) |
| Provisionally Approved | (1) |
| Hospitals or Centers** | |
| Diploma Programs | 78 |
| Fully Approved | (75) |
| Initially Approved | (1) |
| Provisionally Approved | (2) |
| Total Number of Degree and Diploma-Granting Professional Nursing Institutions in Pennsylvania | 113 |

*Source: State Board of Nurse Examiners, Harrisburg, 1973.

**Between January 1974 and June 1976, 14 fully approved hospital schools of nursing plan to close their programs (six in 1974, three in 1975 and five in 1976).

TABLE 4

PRACTICAL NURSING INSTITUTIONS IN PENNSYLVANIA 1973*
(HOSPITAL PROGRAMS, COMMUNITY COLLEGES AND
VOCATIONAL-TECHNICAL SCHOOLS)

| PN Institutions | Number |
|---|---|
| Hospital Programs** | |
| Diploma | |
| Fully Approved | 11 |
| Provisionally Approved | (10) |
| | (1) |
| Community Colleges | |
| Diploma | |
| Fully Approved | 8 |
| Initially Approved | (6) |
| | (2) |
| Vocational-Technical Schools** | |
| Diploma | |
| Fully Approved | 35 |
| | (35) |
| Total Number of Practical Nursing Institutions in Pennsylvania | 54 |

*Source: State Board of Nurse Examiners, Harrisburg, 1973.

**During 1973, three hospitals and three vocational schools closed their fully approved programs in practical nursing. These are not included in the above figures.

TABLE 5

PROFESSIONAL NURSING SCHOOLS IN PENNSYLVANIA, 1969-1973*

| Degree or Diploma Awarding Institutions | Number of Institutions, Calendar Years 1969-1973 | | | | |
|---|---|---|---|---|---|
| | 1969 | 1970 | 1971 | 1972 | 1973 |
| Baccalaureate Degree | 9 | 14 | 15 | 12 | 14 |
| Diploma | 95 | 93 | 91 | 90 | 85 |
| Associate Degree | 5 | 6 | 8 | 10 | 12 |

*Source: State Board of Nurse Examiners, Harrisburg, 1973.